Vol. 11 JANUARY, 1918 No. 3

QUARTERLY

OF THE

National Fire Protection Association

Entered as second-class matter May 1, 1911, at the Post Office at Boston, Mass., under act of July 16th, 1894.

87 MILK STREET, BOSTON, MASS.

EDITED BY THE SECRETARY

National Fire Protection Association.

Executive Office, 87 Milk Street, Boston, Mass.

Franklin H. Wentworth, Secretary

January, 1918

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Western Factory Insurance Association.
Western Improved Risk Association.
Western Insurance Bureau.
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West Virginia Inspection Bureau.
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Wisconsin State Fire Prevention Association

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Reports of fires appearing in the Quarterly are copies of or extracts from written reports forwarded to the Association. This Association, as a body, is not responsible for the statements or opinions of any of its members.

RUINS OF A DEPARTMENT STORE.

The walls of this brick building had been weakened by a previous fire many years ago, but the cracks and other effects of this fire had been concealed by cementing on the outside. Happily the Fire Chief was aware of the dangerous conditions and none of the firemen was caught when the walls fell.

The Quarterly

Vol. 11 January, 1918 No. 3

Fire Prevention by State Educational Institutes. The State of North Carolina is second to none in its fire prevention work which is directed by its able insurance commissioner James R. Young, who is also fire marshal and has just been elected president of the Fire Marshals' Association of North America. Beside putting forward all the other forms of educational work common to the fire marshal departments of other States, North Carolina has worked out unique forms of effort all her own which promise to bring salutary educational results. For example:

Commissioner Young has a State Electrical Inspector who inspects electrical work throughout the State and sees that local inspectors do their duty. He also employs an expert fireman who consults with and advises city authorities as to fire fighting and fire prevention as well as upon what they need in apparatus and how the local firemen can get the most out of it. The latter is accomplished by training members of the various city fire departments. This admirable plan will eventually bring up to standard all the backward local electrical and fire-fighting agencies in the State.

One of the latest moves of the Department is along the line of institute work. In 1916 Commissioner Young held an Electrical Institute and was so well pleased with the results that in 1917 in September, he held both an Electrical and a Firemen's Institute, each lasting two days.

A regular program was carried out at the Electrical Institute comprising papers, addresses and discussions participated in by representatives of the Engineering Department of the Southeastern Underwriters' Association and of the Bureau of Standards at Washington, as well as by State and City Electrical inspectors. This institute was attended by electrical inspectors, electrical supply men and others interested, and proved pleasant and profitable to all who were present at the sessions.

The Firemen's Institute followed with two days of practical work. The Insurance Commissioner and State Superintendent as well as chiefs and assistant chiefs of Fire Departments made the institute intensely practical and profitable with papers and discussions on the work of fire departments both in preventing and putting out

fires. These institutes are something new in this work but are along lines used in other educational work and results already accomplished have satisfied the Commissioner that he has made no mistake in inaugurating the new move. He says the institutes are to be a regular part of the work of his department each year in the future.

* * * * *

Waterfront Fire Protection. Considerable relief is felt by those concerned with waterfront fire protection at the action of the government in putting all waterfront properties under guard. Waterfront fire fighting presents such peculiar problems as to try the nerves of fire commissioners even in times of peace. Some months before war was declared the commissioner of New York attempted to unify public and private agencies along the waterfront of the metropolis. Announcement was made that thirteen railroad and other companies, owning one hundred and forty-three tugs, equipped for fire service, had agreed to place this force at the call of the commissioner. The plan also included the co-operation of all the fire brigades, police and watchmen of the railroad companies in the prevention of fires. The plan is one that reflects the increasing realization of the need for and value of co-operation in the prevention and fighting of fires, and is one which recommends itself to other cities with waterfronts. Scarcely a waterfront fire occurs which does not endanger shipping in the slips or at the docks and the prompt service of privately owned tugs in hauling such craft from their berths is of exceeding value to the fire department, releasing the fire boats for their work of water throwing.

* * * * *

Chicago's Electric Fire Boats. Two boats of rather unusual interest form an important part of the fire-boat squad which for some years has been stationed in the Chicago river, protecting Chicago's river front. These are the twin boats, "Joseph Medill" and "Graeme Stewart," both electrically operated. Principal dimensions of the craft are: Over-all length, 128 ft.; beam, 28 ft.; depth of hull, 15 ft.; draft, 9 ft. 6 in. Steel construction is used throughout except for a small amount of inside finish of deckhouse and pilothouse. Water-tight bulkheads, water-tight hull compartments and strongly reinforced bows constitute construction features worthy of note.

While the boats are propelled by electric motors, the prime source of power on each is a steam turbine, the same one which supplies power to the pumps. This arrangement allows a maximum use of the equipment, as the pumps are not required when the boat is under full headway, and vice versa.

Two centrifugal fire pumps take care of the pumping requirements on each of the twin boats. These pumps are two-stage, and are each capable of supplying 9,000 gal. per minute against a pressure of 150 lbs. to the square inch. By means of a branch pipe arrangement the discharge of one pump may be connected to the suction of

the other, so that the set is, in effect, a four-stage pump. With this connection a 5,000-gal. per minute stream is delivered at 300 pounds pressure. Coming from a 3½-inch nozzle, this stream has a tremendous fire-fighting efficiency.

Power for each pump is supplied by a 660-h. p. Curtis turbine, each turbine shaft also carrying a 200-kilowatt direct-current generator. The electric power generated is carried through suitable control apparatus to the two 250-h. p. direct-current motors, one being connected directly to each propeller shaft. As the motors are of the variable-speed reversing type, the movements of the boat are controlled with remarkable nicety. Independent turbine sets operate the exciters.

Getting under way with the electric fire boats is an extremely simple matter. The engineer starts his turbines, circulating and air pumps, while the captain turns the controller that regulates the speed of the screw motors. On the run to the fire all the power of the turbine is available for driving the boat, as the fire pump impellers are simply turning in their casings. Arriving at the fire, the engineer has only to open the sea cocks, letting water into the pumps.

Electric operation of fire boats as applied in Chicago's twin installation has many features to recommend it. One important advantage of electric over direct steam drive comes from the fact that the propellers cannot race, even when rough going carries them clear out of the water at times. The motors used run at a constant speed, whether running fully loaded, partially unloaded or entirely free from load. Damage to propellers and to the boat itself is prevented in a great degree by automatic circuit breakers, which open the motor circuits the instant a certain degree of overload is reached. Thus in moving down the ice-filled river, if the propeller blade happens to strike a large block of ice, the motor automatically stops, saving the propeller from damage. In a similar manner the motors are stopped in case of a collision with a dock or another boat.

* * * * *

The Aeroplane in Fire Departments. Considerable interest was manifested among our firemen members at the report that the San Diego, California, fire department had put two aeroplanes into service for waterfront fire fighting. Many old fire fighters were somewhat skeptical as to the value of such machines and thought the idea of them rather bizarre. Fire Chief Louis Algren in a letter to the N. F. P. A. outlines their equipment and possible use. Chief Algren says:

> The machine used is a 6-cylinder, water-cooled, 110 H. P. Hydroplane, capable of making 70 miles per hour, and equipped with 4 carbon-tetrachloride and two 3-gallon chemical extinguishers. It is of valuable service in checking a fire until other fire-fighting equipment can be gotten to the scene, and in shallow water where it is impossible for the Fire Tug to reach for aiding such as fishing and pleasure boats, and most valuable in making inspections along the water front, lumber yards and inaccessible places.

The chief further states that on account of the war, the proximity of the U. S. aviation school and the number of warships in the harbor

continually, the use of the hydroplanes has been discontinued for the present, as it has been forbidden by the government to fly in the vicinity of the above named government property.

* * * * *

Wood Stave Pipe. The high cost and difficulties in the way of delivery of metal pipes for water service are bringing out inquiries regarding the use of wooden pipes for underground mains. In reply to a letter from our member, the National Lumber Manufacturers' Association, on this subject, Mr. Geo. W. Booth, chief engineer of the Committee on Fire Prevention of the National Board of Fire Underwriters, said:

> It is true, as you suggest, that wood stave pipes are used to a considerable extent, especially on the Pacific coast, for water supply purposes, some of these mains being very large ones. These pipes are used mostly for long supply lines and have given mainly good satisfaction. The service record of wooden pipes for distributing purposes in city streets has not been nearly so satisfactory. A large amount of wood stave pipe has been used at the army cantonments constructed during the past summer. Most of this pipe was in rather long straight runs, and for bends and specials, such as hydrant T's and branches, it was thought best to use cast iron pipe. Experience at the cantonments also indicated that there is a great difference in the quality of the wood pipe furnished by the different manufacturers, both as respects material and workmanship. Some of the lumber used was of poor quality, with many knots and other defects, and in some cases proper care was not taken to keep sharp the tools used for cutting the tenons on the end of the pipe and to keep these tools properly centered with the pipe.
>
> As above indicated, wood pipe has been used mostly, and with the greatest degree of success, for long lines without many bends or specials and without many service connections, and it is our opinion that it is best fitted for this type of service and not very well fitted for distributing pipes. We believe that the objections to wooden pipe will apply to its use in a manufacturing plant, since there will probably be a good many bends and special fittings, together with hydrant branches and other connections. There is also the question to be considered of the length of life of such pipe; the usual opinion is that it cannot be depended upon for reliable service for more than ten or fifteen years.
>
> To sum up, it is our opinion that wood pipe of good quality has a proper place in water works practice, especially under present conditions, with cast iron pipe so high in price; however, we do not consider that this place is in yard main systems, nor city distribution systems, especially where only a comparatively small amount of it is to be used and the installation is not likely to receive the same expert attention as on the larger jobs.

* * * * *

Arkansas and The Fire Waste. It appears that under the laws of the State of Arkansas a man may burn his own property without incurring any legal penalties. A decision of the Arkansas Supreme Court to that effect is thus commented upon in a recent issue of the *Baltimore Underwriter*:

> The act of burning one's house is not arson in that State, that is provided no injury is thereby inflicted on the life or property of another. Under the decision cited, if the burned property were insured no claim against the insurer is valid. This, on first consideration, seems consistent with the reasonable doctrine that a man may make such disposition of his property as suits his interests, inclinations or pleasure. But this cannot be true. The deliberate destruction of instrumentalities valuable or useful to the progress or comfort of mankind—and that which fire destroys is absolutely annihilated—should

be classed as a crime. Property in a wooden house, a shelter for human beings, differs only in degree from property in the land on which it stands. If it were possible to annihilate land no man with any sense at all could be found who would justify the act. Such an act would be regarded as amongst the most heinous of crimes, for it would strike at the vitals of human interests. A man may give away his property, whatever its form, but he cannot put it out of existence without injuring the interests of the race. He who burns his house does not thereby rid himself of the necessity of the shelter it afforded him. He must secure that shelter in another house. He has simply deprived his community of a habitation. The injury is to the community, not to the incendiary.

We trust that the sound doctrine of the *Baltimore Underwriter* will not be slow in making headway in official circles. Just as the individual citizen cannot live to himself in this matter, neither can the individual State live to itself. We have only to imagine the possibility of some anti-social fanatic in a fit of "the-public-be-damned" spirit, destroying large stocks of food or other necessities of life, to realize the absurdity of the existing situation and the urgent need for stressing the rights of the community.

* * * * *

The Halifax Disaster. Our first word on the terrible explosion which reduced sections of the city of Halifax and its suburbs to ruins on December 6th must naturally be one of sympathy. The Association is represented in the city by a number of good and loyal members and we earnestly hope that not only they but all who are dear to them are among the survivors. It is, of course, too early for a final and authoritative report; but if the story that quantities of gasoline were being transported in wooden barrels along with a large stock of high explosives be true, and if this is a common practice on munition ships, the only wonder is that the disaster was so long delayed. Although the circumstances of its occurrence give it a special place in the public mind, the desolation of Halifax presents much the same problems of relief and rehabilitation as do the historic conflagrations of peace. If we could only inject into the public mind an abiding realization that trivial acts of carelessness have again and again resulted in calamities less only in degree than that over which Canada is now mourning, we should be able to look forward to the future with a new confidence.

* * * * *

The Watchman Again! We have had not infrequent occasion in recent years to call attention to the importance of employing none but able-bodied and vigorous men to perform the duties of a watchman. It is, however, possible for watchmen to be a trifle too active and quick with their weapons, as is proved by a recent incident at Shreveport, La. The fire department received a call from an outlying district to help save a considerable quantity of corn from fire. Apparatus was immediately dispatched, and as it passed the watchman's office at a toll bridge, the Assistant Chief in charge waved at the watchman, who had started inside. The watchman reappeared with his gun and fired five shots at the wagon,

the Assistant Chief having a very narrow escape when a bullet struck a ladder rung in front of his face and glanced away. The watchman's excuse was that the fire wagon resembled a large truck which had previously avoided paying toll.

* * * * *

Fires in the East. Apropos of the recent great fire at Salonika, we notice in our French contemporary, *Le Sapeur Pompier*, some comments taken from the *Gaulois* upon the appalling fire waste of the Far East. "This scourge in the countries of the Levant assumes proportions of which we in France cannot form the slightest idea," says the *Gaulois*. Wooden construction is cited among the principal causes, others being narrow streets, defective water supplies and the absence of fire departments. It is interesting to note that the cigarette stub has won recognition among the causes of conflagrations as far away as Turkey, and after one spectacular waterfront fire due to a careless smoker on one of the bridges, a special *irade* was issued—with Oriental penalties attached—forbidding the smoking of cigarettes in public places—on the bridges, in the streets, in the cafes, on the promenades. The pipe was, however, permitted. Frugal France can afford to poke fun at the Turk in this matter, but we Americans—as we reflect that of 1,414 fires reported in Paris during 1915 only 271 caused a loss of more than $193, and that the total expenses of the fire brigade during the year amounted to but $653,135, as compared (say) with the expenditure of $9,197,142 by the Fire Department of New York City in 1916,—may perhaps congratulate ourselves that the eyes of the *Gaulois* critic were turned eastward and not westward.

* * * * *

A New Punishment for Arson. A retired minister convicted of setting fire to the home of his attorney was recently freed by Justice Houser of the Los Angeles Superior Court on condition that he stay outside of Los Angeles county. The decision would seem to indicate a condition of mind very similar to that which, a century ago, sought to make the British colonies dumping grounds for British felons, except that the banishment in the present instance had no unpleasant stipulations attached to it. Inasmuch, however as the firebug was also suspected of having, a few months previously, fired an apartment house of which he was manager, it will be seen that his punishment was more severe than at first appears; for should he continue his activities beyond the area from which he is barred he is likely before long to encounter judges of a different temper from Justice Houser.

* * * * *

The Christmas Hazard. On the whole the Christmas celebrations of 1917 seem to have passed off with fewer holocausts than at one time there was reason to expect. A $378,000 fire which drove 16 families to the streets in their night

clothes, was reported from Long Beach, N. Y., as the result of a Christmas tree blaze, and we have seen one account of a fatality due to an inflammable Santa Claus disguise; but the general fire record is less unsatisfactory than we had feared would be the case. The suggestion (to which wide publicity was given) that lighted candles should be placed in windows behind Red Cross "service flags" on Christmas Eve naturally caused grave apprehension among fire preventionists, but the prompt action of our member the National Board of Fire Underwriters, and the sympathetic and vigorous co-operation of the Red Cross authorities, when this hazard was brought to their attention, were obviously effective in minimizing the peril. All concerned in the eleventh hour precautions are to be heartily congratulated on the fact the Red Cross did not add to its old association with the horror of the battlefield a new association, of a very different kind, with the horror of fire in the home.

Chicago Lake Front at Night.

At the edge of a beautiful gulf of gloom and stillness
The city rises—
Glittering with millions of spangles
Seen between the dull smoke of the trains,
That struggle and tug laboriously
And bump empty freight cars into each other
With a noise like surf collapsing.

1917 Fire Losses $267,273,140.

From the Journal of Commerse.

The losses by fire in the United States and Canada during the year 1917, as compiled from the records of *The Journal of Commerce and Commercial Bulletin*, aggregate $267,273,140, the heaviest of any year in the history of the country except 1906, when the great San Francisco conflagration swelled the total to $450,710,000. The 1917 record is nearly thirty-six millions in excess of the previous year's figures and over eighty-four millions larger than the fire losses of 1915. The higher values of all classes of property may have been accountable for some of the increased losses, but it is also notable that the number of fires also shows a proportionate increase.

The world war was a contributing factor in 1917's unusual record, as will be seen from the detail figures, which reveal the destruction of a considerable number of plants engaged in the manufacture of war munitions. In some instances where the heaviest war munition losses occurred there was little or no insurance against fire carried, and the underwriters therefore made a lucky escape. The notable munition plant losses included the Canadian Car and Foundry's plant at Kingsland, N. J., involving a loss of $12,000,000; the Du Pont powder plant at Haskell, N. J., causing $1,500,000 loss; the munition plant of the Union Switch and Signal Company at Pittsburg, causing a loss of $4,200,00, and the Washburn Wire Works at New York City, with a loss of $1,100,000.

While the national movement for the safeguarding of foodstuff warehouses and grain elevators has reached a fair degree of efficiency, there were a number of heavy losses in these classes of risks during the year, and the aggregate resultant loss amounts to considerable. Another rather unusual run of losses was the large number of heavy oil tank fires in the Southwestern field.

The aggregate fire waste of the United States and Canada during the past forty years, from 1878 to 1917, inclusive, reaches the appalling total of $6,480,267,560, showing an annual average property destruction of $162,006,689. It is generally conceded by those who make a study of fire loss causes that fully 65 per cent of the fires of this country are due to preventable causes. On this basis of calculation the preventable fire losses of the country during the past forty years reach the total of $4,212,173,900. The following table, giving the losses by years during the past forty years, shows, despite an occasional decrease, the tendency is generally upward in the aggregate loss, but this may be accounted for in the larger values of the property exposed to the fire hazard:

FIRE LOSSES DURING PAST FORTY YEARS AGGREGATE $6,480,267,560.

1917	$267,273,140	1897	$110,319,650
1916	231,442,995	1896	115,655,500
1915	182,836,200	1895	129,835,700
1914	235,591,350	1894	128,246,400
1913	224,728,350	1893	156,445,875
1912	225,320,900	1892	151,516,000
1911	234,337,250	1891	143,764,000
1910	234,470,650	1890	108,893,700
1909	203,649,200	1889	123,046,800
1908	238,562,250	1888	110,885,600
1907	215,671,250	1887	120,283,000
1906	459,710,000	1886	104,924,700
1905	175,193,800	1885	102,818,700
1904	252,554,050	1884	110,008,600
1903	156,195,700	1883	110,149,000
1902	149,260,850	1882	84,505,000
1901	164,347,450	1881	81,280,000
1900	163,362,250	1880	74,643,400
1899	136,773,200	1879	77,703,700
1898	119,650,500	1878	34,315,900

The losses by fire during 1917, when considered by months, show a very general increase, with the exception of March and July. The following table affords a monthly comparison of the losses during the past three years—1915, 1916 and 1917:

	1915	1916	1917
January	$20,060,600	$21,423,350	$36,431,770
February	13,081,250	24,770,770	29,587,660
March	18,786,400	38,680,250	17,523,000
April	18,180,350	12,681,050	18,597,225
May	11,388,450	15,973,500	24,968,800
June	10,893,950	12,247,500	15,513,270
July	9,006,800	23,013,800	16,143,050
August	10,067,100	10,745,000	21,751,100
September	14,823,500	12,244,625	13,814,490
October	14,465,850	17,701,375	26,384,450
November	21,204,850	19,898,450	20,198,025
December	20,877,100	22,063,325	26,360,300

There were no less than 3,150 fires during 1917, which in each instance caused an estimated property damage of $10,000 or over. This compares with 2,857 such fires in 1916 and 3,152 fires of a similar magnitude in 1915. The following table, giving the monthly record of the fires of $10,000 or over during 1917, classified according to their destructiveness, will be found of interest:

	$10,000 to $20,000	$20,000 to $30,000	$30,000 to $50,000	$50,000 to $75,000	$75,000 to $100,000	$100,000 to $200,000	$200,000 and over	Total
January	101	64	45	25	10	35	23	303
February	132	72	59	41	11	37	29	381
March	89	56	32	28	16	32	17	270
April	74	45	27	33	12	35	18	244
May	71	53	41	31	19	26	20	261
June	86	35	36	24	6	26	17	230
July	67	42	30	18	13	23	18	211
August	73	38	28	26	11	19	16	211
September	69	37	29	23	6	13	16	193
October	88	53	26	27	19	28	29	270
November	108	41	36	36	23	19	21	284
December	73	45	38	44	18	47	27	292
Totals	1,031	581	427	356	164	340	251	3,150

Fire and Accident Prevention Day in the Schools at Grand Rapids.

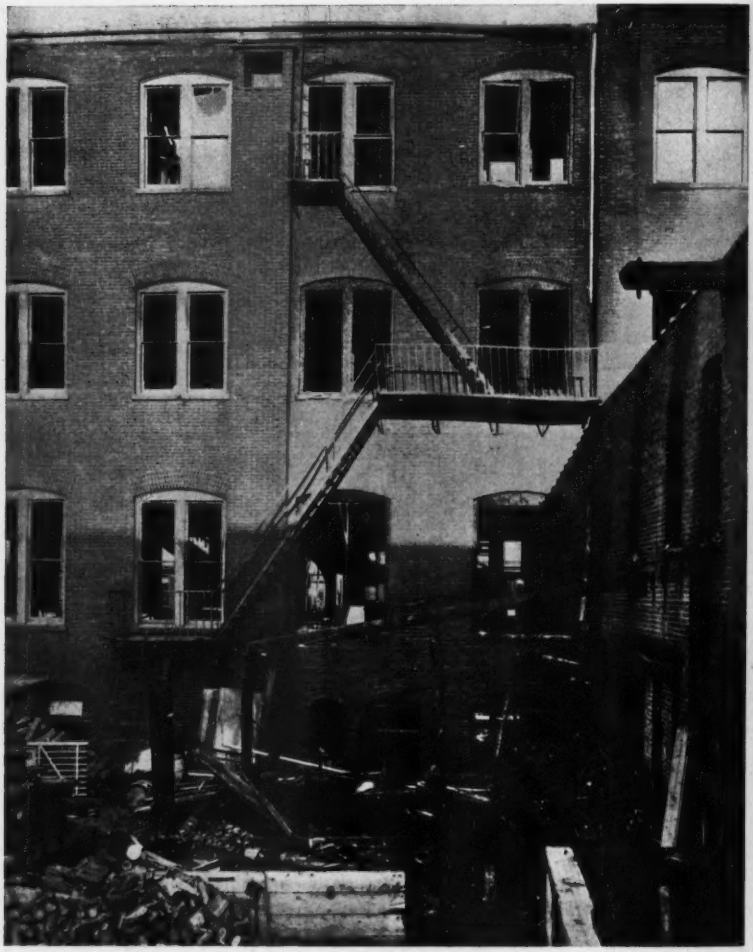
We are indebted to our member, the Michigan Inspection Bureau, for the above photograph, showing how on October 9th, 1917 the pupils in the schools of the City of Grand Rapids, Michigan, were instructed in the mechanism of a public fire alarm box. This particular picture was taken on the stage of the auditorium of the Central High School, but similar instruction was given in all the schools. So great was the interest aroused by this little demonstration that our member was encouraged to take up the idea of giving a fire prevention exhibit at the West Michigan State Fair to be held in the city in 1918, and it is understood that plans are now well under way for this exhibit. The City Fire Department will co-operate and space has already been promised by the Fair Association.

Loss of Life from Common Hazards.

Apart from the appalling disaster at Halifax, N. S., to which we refer elsewhere, there have occurred, since the last issue of the QUARTERLY two notable fires involving loss of life on a smaller scale, one of them being the holocaust at a Salvation Army Rescue Mission at Paterson, N. J., and the other a tenement house fire in Lowell, Mass. In the Paterson case, nineteen men were sacrificed on the altar of bad housekeeping and poor construction. The fire originated in a heap of magazines and papers in the rear of the building, and piles of kindling wood in the yard served as fuel for the flames, which spread rapidly and soon enveloped the entire structure. Only the heroic efforts of firemen and police officers prevented a longer list of casualties. A heap of bodies was found after the fire, wedged against one of the main entrances. It was stated that "the general belief was that the structure was fire-proof." Inasmuch as the institution was maintained by the generosity of prominent citizens it is no more than fair to assume that it was generally taken for granted that the building could not burn, but this fact in itself emphasizes the terribly backward state of public education in these matters and the frightful consequences that are at any time liable to ensue therefrom. We reproduce herewith a photograph of the rear fire-escape, which was the only "complete" one, and which was rendered useless from the start of the fire.

The second instructive disaster occurred at Lowell, Mass., in which city, however, a Fire Prevention Bureau is now being formed and the Fire Chief of which has recently been enrolled as a member of the Association. In this instance a three-story tenement house of the cheapest construction was unprovided with fire escapes of any kind. Nominally there were two exits, and, presumably on this account, fire escapes were not required by the municipality. We learn from a well-informed correspondent that the exits were situate at the front and rear of a single hallway and that unenclosed stairs ascended to a common landing over a row of closets which were used by the tenants for storage purposes and in one of which the fire originated. It is believed that ashes in wooden barrels were freely stored in the closets. The hallway extended practically to the roof of the building and contained no partition. Under such conditions it is obvious that the second exit had little, if any, practical value. Five of the victims were either burned to death or died almost immediately from their injuries: a number of others were seriously hurt, two or three being considered unlikely to recover.

"The tenement house department finds defective fire escapes all over the city, even on new-law houses." Commissioner John J.



The "complete" fire escape which proved useless at the fire in the Salvation Army Rescue Mission, Patterson, N. J.

Murphy, of New York, is reported to have stated in a warning recently issued. "In calling attention to my exhibit at the State Fair," says Insurance Commissioner James R. Young, of North Carolina, "I was very much surprised at the number of people who told me of the death by fire of their children. Why is it so hard to make our people realize the great loss of life and property in this State every year?" In a special bulletin November 16th, 1917, sent to us

by Superintendent of Fire Prevention J. E. Florin, the Industrial Commission of Wisconsin mentions no less than 7 fatalities, in less than as many weeks, coming to its notice as a result of starting fires with kerosene and children playing with matches. Several non-fatal accidents from the same two causes are also mentioned. It is cheering to be able to record simultaneous recognition in such diverse quarters that a conservation movement which should overlook the conservation of the most precious of all forms of wealth—the source, in fact, of all other forms—human life, would be failing in its most important function.

We append as usual a number of newspaper clippings illustrating the extent of the evil. Some of these were obtained directly by the Executive Office; for the remainder we are indebted to the co-operation of various members of the Association:—

FILLMORE, Oct. 2.—Two forest fires in the hills back of this town today caused the loss of six lives and destroyed oil derricks, pipe lines, buildings and other property to a value estimated tonight at $500,000.

The list of the dead includes Ruth Sansler, a young woman, Mrs. O. E. Webb and one of her children, and Walter Matthews, all of whom were employed on or living at the Anaconda lease of the Union Oil Company. R. A. Prindle of the Leonard gasoline plant is known to be dead, and the unidentified body of a woman has been found.

Miss Sansler, it was reported, was fleeing from the fire with her brother when she stumbled and fell; her brother retraced his steps and attempted to assist her, but his clothing caught fire and he was severely burned and was unable to rescue her.

The larger fire, the one in which most of the lives are believed to have been lost, was started Friday morning and was believed to be under control until early this morning, when a high wind caused it to spread so rapidly that persons on the various oil leases were taken unawares and were unable to effect their escape.

The smaller fire is in the vicinity of Henley's camp, a summer resort on Piru Creek, and it was said tonight that the resort was in serious danger. No late reports from the scene had been received. A force of fire fighters was engaged here also in attempting to control the flames.

Lack of rain and consequent dryness in the timber and underbrush made the menace greater in both fires.

WEED, Cal., Oct. 5.—The east end of Main Street lost by fire twenty-seven business houses, entailing a loss of $150,000. Eight dwellings were also consumed. V. O. Alfire, proprietor of the Weed Bakery, where the fire originated, perished in the flames while trying to save some keepsakes.

TORONTO, Ont.—While playing with matches yesterday evening, May Karney, aged four years, of 69 Maria Street, accidentally ignited a pair of curtains. The flames spread to the child's clothes, and her cries attracted the attention of her mother, who quickly smothered the flames. The child was rushed to the hospital for Sick Children, but her injuries were so severe that she died a short time later.

THE PAS, Man., Oct. 16.—Austrian construction workers on the Hudson Bay Railway at Mile 214, on Friday last, attempted to light a fire in a bunk-car with a can of gasoline; an explosion resulted. The car was occupied by eight Austrians. One is dead and one dying in the hospital here; others are badly burned. The car caught fire and was entirely consumed.

LOWELL, Mass., Oct. 30.—Winifred A. Dion, 5-year-old daughter of Mr. and Mrs. John A. Dion of 6 Lanes Court, was fatally burned tonight while sleeping in her bed. Curtains blown by the wind against a lighted gas jet started the fire. The child died a few hours later in the City Hospital.

WEIN, Wis., Nov. 1.—August Hannamann, 69 years old, and his son, Gustav, 34, were burned to death when the saloon of the latter was destroyed by fire. The men lived alone. The fire was discovered at midnight when entire structure was

a mass of flames. The bodies were found in the kitchen near a door through which the men had sought to escape.

ST. PAUL, Minn., Nov. 6.—Mrs. L. W. Dudley, 31 years old, living at 372 N. Exchange St., was fatally burned about 9 A. M., when her clothes caught fire while she was attempting to light a fire.

A neighbor, living on the floor above, heard her screams, and rushing downstairs found Mrs. Dudley lying on the floor aflame. The injured woman was taken to the City Hospital.

SHREVEPORT, La., Nov. 14.—Five men were burned to death, two others seriously injured, a number of others sustained minor injuries, and property loss estimated at $8000 was caused when fire destroyed the Philips House, a hotel of Many, La.

PITTSFIELD, Mass., Nov. 14.—Adèle Baccoli, four-year-old daughter of Angelo Baccoli, died in the House of Mercy Hospital today of burns suffered when she set fire to a bed, on which she was playing with matches, at the home of an uncle.

MILBRIDGE, Me., Nov. 27.—Alexander Stanwood and his wife of Wyman, were burned to death in their camp on Dyer's Island, Narragangus Bay, today. They had dashed into the burning building in an attempt to recover some money, and perished while neighbors were trying to rescue them.

BUTLER, N. J., Dec. 3.—Moses Miller, 45, his wife and their seven children perished here when fire destroyed their farm house early today. The house was in ruins, due to a high wind, when firemen arrived.

BATAVIA, N. Y., Dec. 3.—Three children of Mr. and Mrs. Antonio Madonia of Oakfield were badly burned by the overturning of a kerosene lamp in the living room in the rear of the Madonia store last night. The lamp fell into a baby carriage in which Samuel, aged one year, was sitting. Sarah, aged seven, and Grace, aged 3, were burned in heroically trying to rescue their little brother from the blazing carriage.

It was reported this evening that the infant would probably die within a few hours as a result of burns. The baby also inhaled flames. Sarah's hair was burned off and the faces and hands of both girls were burned. The children were alone when one of them pulled the lamp over.

Joseph Sapienza and his sister, Frances, entered the store to make some purchases when they heard the screams of the children. After wrapping the children in blankets to smother the flames they extinguished the fire with pails of water.

BATAVIA, N. Y., Dec. 11.—The Frank W. Langworthy business building, at West Main and Walnut streets, burned nearly to the ground today, causing a loss of about $25,000. Mrs. Mary Jane Wilber, aged 74 years, was burned to death. An investigation disclosed that she had gone back into the building to find her pocketbook.

SPRINGFIELD, Mass., Dec. 14.—David C. Lovemoney, long in the optical business here, was killed in his private garage today. While working under his car an explosion of gasoline occurred, followed by fire, and Lovemoney's body was burned to a crisp. His wife, who heard the explosion, found the garage doors closed and the interior a mass of flames.

MEDINA, N. Y.—It's dangerous enough for an adult to start a fire with kerosene. An eleven-year-old boy in Medina was allowed to try it. He's dead, with his mother and brother.

OAKLAND, Cal.—The lives of eleven children were saved by the bravery of Mrs. A. Myer. Eleven children were trapped in the upper story of a two-story dwelling when a fire of mysterious origin broke out shortly after midnight. The children escaped being burned to death by a narrow margin. All were awakened by the crackling of the flames and Mrs. Myer rushed to the stairway to find it a roaring furnace. She quickly returned to the children and set about to save their lives, lowering them to a projecting porch by a rope made of sheets tied together. The fire department soon arrived on the scene and was there just

in time to save Mrs. Myer's life, as she had become trapped in the upper part of the building.

Our Canadian contemporary, *The Monetary Times,* is doing good work in keeping this aspect of the fire waste constantly before its readers. We reprint herewith its comment upon the loss of life by fire in Canada during the month of October, 1917.

The fires at which fatalities occurred were:—

Montreal, Que., Oct. 3	Playing with matches	1
Fillmore, Ont., Oct. 3	Fighting bush fire	6
Montreal, Que., Oct. 9	Playing with matches	1
Sarnia, Ont., Oct. 14	Ignited clothing	1
Tillsonburg, Ont., Oct. 5	Trapped in burning silo	1
East Angus, Que., Oct. 12	Trapped in burning house	1
Toronto, Ont., Oct. 16	Playing with matches	1
Little Shemogue, N. B., Oct. 16	Playing with fire	1
St. Stephens, N. B., Oct. 19	Trapped in burning house	1
Toronto, Ont., Oct. 17	Burns from oil stove	1
Le Pas, Man., Oct. 16	Lighting fire with gasoline	2
Toronto, Ont., Oct. 23	Explosion of oil stove	1
Toronto, Ont., Oct. 25	Ignited clothing	1
Estevan, Sask., Oct. 24	Trapped in burning house	1
Avonlea, Sask., Oct. 12	Burns from exploded kerosene can	1
Kerrimuir, Alta., Oct. 25	Overturned lantern	1
Montreal, Que., Oct. 24	Exploded oil lamp	1
	Total	23

Loss of child life this month is again high, one-third of the fatalities being children either playing with matches or fire; quite a few adult cases arise from exploded oil stoves. This year to date 171 lives have been lost in fires.

The following table compiled by *The Monetary Times,* shows deaths caused by fire during the first ten months of 1917, as compared with previous returns:—

	1910.	1911.	1912.	1913.	1914.	1915.	1916.	1917.
January	27	27	27	14	26	3	10	21
February	15	12	11	21	18	11	23	19
March	20	18	24	22	27	23	23	20
April	37	20	15	11	22	14	6	15
May	15	28	18	33	8	5	14	12
June	52	13	6	18	12	2	6	9
July	15	110	9	9	8	13	268	19
August	11	22	16	29	3	14	30	12
September	10	13	6	27	9	27	6	21
October	16	17	21	15	9	7	39	23
Totals	218	280	153	199	242	119	425	171

The Beheaded Sprinkler.

By Paul Mason.

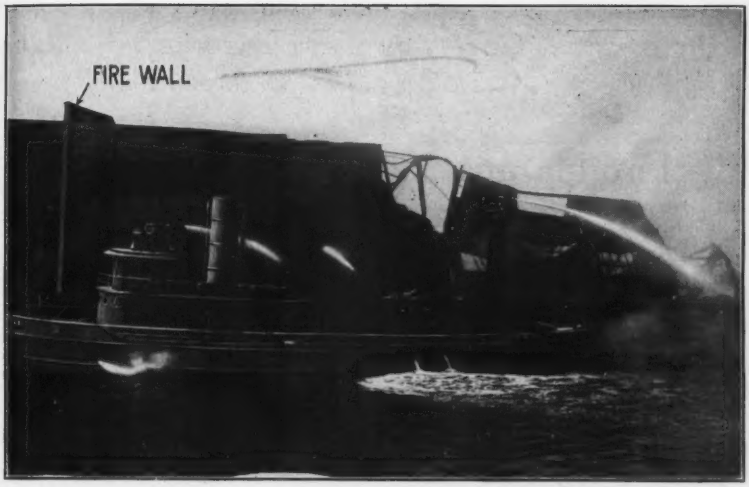
(Member N. F. P. A.)

A sprinkler sat on his pipe, alone,
Like a shabby king on a shabby throne;
The room was dark—at the foot of a stair—
And few there were that saw him there;
His head was gray with the dust of years,
But he held his peace—and his pent-up tears.

Day followed night, and the night the day,
And things went along in the same old way.
There were few who passed through his throne-room dim,
And fewer still who regarded him;
But he held to his pipe, nor worried a mite—
He knew his job, and stuck to it—tight.

Then one day came a wisp of smoke—
A tongue of flame—and like hammer stroke
He leaped to the job that he knew was his;
A pop, a splash, and a dying fizz—
The flame was gone and the fire was dead,
But the sprinkler had lost his hoary head.

"After all," said he, as they took him away,
"I stuck to the job till I had my day;
I knew my task, and there I stayed,
To call the bluff if 'twas ever made.
'Tis better by far than a dozen dead
That I should have stayed till I lost my head."



The fire wall which saved the rear half of Pier 8 of the Baltimore and Ohio Railroad at Baltimore.

Fire Wall in Baltimore Pier Fire.

The accompanying view of the recent fire on Pier 8 of the Baltimore & Ohio R. R., at Baltimore, Md., shows how a reinforced concrete fire wall projecting above the roof isolated the fire which destroyed all of the adjoining Pier 9 and the forward end of Pier 8.

Pier 8, completed in 1908, was built with concrete piers on piling, the piers supporting steel columns that carried the second floor and roofing. The first floor was supported on piling capped and decked at the floor line 8 ft. above the water. The steel frame was covered with corrugated iron, the roof covering being of composition slag. The floors were of heavy mill construction. The pier was divided into two sections by a reinforced-concrete fire wall projecting 4 ft. above the roof. This fire wall, in addition to affording vantage points for the firemen and tug-boats to fight and retard the progress of the flames as the fire was rapidly spreading toward the land, effectively stopped the fire and saved one-half the pier. The fire protection consisted of 6-in. water pipe, running the whole length of the pier, with sufficient number of fire lines with hose to cover the entire area of the pier, supplemented by numerous barrels of water and buckets.

Fire Hazards in Chile and Mexico.

By J. J. Lamont

Assistant Secretary, National Safety Council

(Formerly Foreign Fire Inspector for a British Insurance Company)

The following observations on the fire hazards of Chile and Mexico are based on experience, both as a resident foreign Fire Inspector and as one of those adaptable officials who, armed with camera, portable typewriter and credentials, flit from country to country for the purpose of seeing all that there is to see and drawing correct inferences therefrom, either as helpful missioners in districts where business is already being transacted or as prospectors in regions as yet uncultivated by the companies they serve.

Moral Hazards.

So far as Mexico is concerned, the moral hazard has, of course, been seriously affected during the recent period of political disturbance. The northern portions of the Republic in particular have acquired an unenviable reputation, more than half of the total number of fires being in all probability incendiary. The southern portions have generally had a good record in the matter of incendiarism. It is only fair, also, to say that, notwithstanding poor construction, poorer management, and an abominably low standard of electric wiring, the cotton mills of the country have suffered less from fire than might have been expected, and that among the redeeming features of these properties is to be counted excellence of "morale." The mixed character of the population, particularly in the cities, cannot, however, be disregarded in estimating the moral hazard. Both in Mexico and Chile there are large collections of "hard cases" from all over the world, whose presence is the reverse of beneficial; and attempts to estimate the general moral hazard of particular districts are often complicated by racial prejudices. The Turk and Arab inhabitants of Chillan, in Chile, for example, were looked upon askance at the time of an inspection by the writer in 1911, though on inquiry it appeared that no fire had started in premises tenanted by people of those races for a decade. Nevertheless, the moral hazard in both Mexico and Chile is relatively severe and calls for ceaseless vigilance.

Construction in Chile.

For underwriting purposes in Chile buildings are divided into four classifications, as follows:

(1) Solid Protected—massive construction, with fire walls.

(2) Solid—massive construction without fire walls.

(3) Light Protected—light construction, either with fire walls or detached a certain distance.

(4) Light—light construction without fire walls and not detached as required for "Light Protected."

Of course, in a country nearly 3,000 miles in length, and with great climatic variations, all classes of construction are in evidence. In the North, the Republic is arid and hot; the middle region, in which Valparaiso and Santiago are located, is temperate, with one of the most dependable and delightful climates in the world; while in the South it is colder and there are heavy winter rains. The types of construction encountered include adobes (heavy mud blocks), brick (larger and softer than the United States variety), tabiques (light mud bricks set between timber uprights and often covered with small-channel corrugated iron), frame, and corrugated iron. In a few of the larger towns bastard forms of armored concrete construction have come into vogue since the Valparaiso earthquake of 1906. Roofs are mainly corrugated iron and tile. There are conflagration towns galore, principally in the North and the South. In 1909 an incendiary fire starting in a candy store in the German-Chilian town of Valdivia, in the South, burned twenty-five blocks before it was extinguished.

Some notes from a report made some years ago by the writer on the typical Chilean town of Chillan, situated 244 miles south of Santiago and having a population of about 30,000, may be of interest. About 95 per cent of the buildings were one-story, and the remaining 5 per cent two-story structures. There were only three three-story edifices in the town—a dwelling, a hotel and a flour mill. Municipal building regulations were non-existent, and in the poorer blocks there were a number of unimportant buildings constructed of cane and mud. The commercial area contained many solid party walls, but in a number of instances these did not extend to the roofs, or they were discounted by the existence of wooden box or other cornices which they did not cut. Many blocks had long lines of unbroken heavy tile roofings, in which there were concealed spaces. Probably about a fifth of the buildings were really "solid," the bulk of the remainder being "mixed," i.e., either solid external walls on the four sides, with some tabique or wood and iron construction in the interior; or having a "light" upper story. Perhaps a tenth of the whole were entirely "light" construction.

Construction in Mexico.

Conditions vary widely in the different provincial towns of Mexico, which are roughly graded for underwriting purposes according to the extent to which they fall short of the standard set by Mexico City. The best group of provincial towns is regarded as being 85 per cent as desirable as the capital. In view of its "standard" character, therefore, a somewhat detailed description of the construction of Mexico City may be of interest.

Mexico is essentially a "massive" city. Broadly speaking, there are four distinct classes of construction. The old Spanish type is

very massive, having walls up to 1 m. 20 c.m. thick, built of "tezontle," a natural compound of silica and volcanic ashes. The floors are of heavy beams and planking (often underdrawn with canvas in dwellings and offices, as there are no overhead plastered surfaces) supporting a thick layer of earth and stone refuse, called "cascajo," with thin bricks for flooring. Roofs are of the same construction as floors, and are, of course, flat. This class of construction is generally of two stories, though sometimes of one or three; it has open interior courtyards ("patios"), and it includes about a third of the total number of city buildings. Many of the shops, warehouses and offices in the central area of the city are reconverted dwellings of this old type. A good number of these old buildings have sunk somewhat and some of their walls are off the perpendicular.

In the second, or ordinary modern type, the walls may be of "tepetate" (a white marlaceous substance quarried in the valley of Mexico, which becomes almost as hard as cement when exposed to atmospheric action); of "adobe," or of brick. The buildings vary from one to five floors in height. The floors are often wood joists and planking, frequently underdrawn with canvas as in the old Spanish type; but may consist of iron I-beams either with centerings of corrugated iron supporting a mass of "cascajo" on which plank flooring is laid, or with brick arches over which concrete or cement is floated. Structural metal work is generally unprotected, as are the floor openings. There are three types of roof in connection with this class of construction—the flat roof, consisting of thin bricks laid on "cascajo," the iron or tile roof found mainly in the newer buildings in the residential districts, and the mansard roof, of which there are many in the commercial quarters, generally of wooden framework covered with metal. As regards the building materials in this class, it may be observed that "tepetate" blocks do not take mortar well. There is practically no cohesion between the surfaces, and it is essential to employ brick bonds and stringers as strengtheners. The material has, however, a fair reputation from an earthquake point of view and resists fire fairly well. "Adobe" is not very popular, the reason being that it retains moisture. On the other hand, it holds together well, and in fact becomes, after a lapse of years, a homogeneous mass, and it is a good fire-resistant. The brick is often of poor quality, not hard-burned, and the mortar, which is also inferior, is laid too thick. Cement is altogether too expensive to be widely used, and the sand used in mortar preparation is usually wretched stuff, simply taken from openings in the earth.

The influx of North Americans into Mexico City is mainly responsible for the introduction of steel construction—the third class. Some of these structures, particularly the most recent, are excellent examples of armored concrete work, all metal members being duly protected. There are, however, a number in which this important feature has been neglected.

View in Mexico City. Note roof structures.

The last class, Inferior or "Light" Construction, is principally confined to wood and corrugated iron erections on the flat roofs, occupied as domestic offices, storerooms or photographic studios, although there are some interior sheds of this type, and a very few buildings with inferior construction in external walls. The roof structures, for the greater part, have no direct internal communication with the buildings on which they are erected, and are not penalized by Insurance Rating Schedule unless they occupy a greater area than one-quarter of the roof. Photographic studios, however, generally do communicate with the building below, and apart altogether from the possibility of a fire breaking out in such flimsy structures and burning downwards, there is also the "flying brand" hazard to be kept in mind.

Glass in roofs, of which there is a good deal, either as skylights or monitors, in the mercantile district is almost always unprotected by netting. Practically all interior division walls, both in the old and modern types, are of massive material; lath-and-plaster work is not a constructional feature. There are, however, partitions of wood, covered with wire netting and plaster in some of the new dwellings. In the compactly built quarters of the city, fire walls are generally good, and usually pass through roofs, forming satisfactory "cut-offs." So many of the roofs being flat, it seems logical that such walls should rise above the level surfaces, and form demarcation lines beyond which neighbors may not pass. Some "through beams" exist, but this feature does not seem to have contributed to the spread of fire. Indeed, considering the inefficiency of the fire brigade and water supply, it is surprising how fires are confined to single properties; but, of course, the good construction facilitates

this, and when heavy roofs fall in they serve to smother fires. Except in the more modern and flimsier types, walls usually remain intact after fires. There are practically no wooden cornices in the commercial areas, and only a few wooden balconies. The buildings vary in height in the commercial district from one to seven stories, but the majority have two or three floors. The tendency of new construction in this quarter is all toward greater height.

Although there is plenty of poor construction in the provincial towns, their grading for underwriting purposes does not necessarily correspond closely with constructional conditions. The moral hazard and the deficiencies, or even complete absence, of public fire protection are also important factors. Thus towns like Torreon and Monterey, which are placed in Classes II and III, respectively (representing degrees of desirability 30 and 40 per cent lower than the capital) contain much solid construction. In Torreon the bad blocks are mainly on the outskirts, and in Monterey light construction is infrequent in the principal quarters, the low class structures being practically confined to the northern and western areas. Monterey possesses a few examples of fire-resistive construction, including an excellent five-story and basement hotel building in the centre of the town. The writer also has a lively recollection of an exceptionally well constructed brewery, almost wholly fire-resistive, with the exception of the bottling house, which had a wooden first floor and a wooden roof. Incidentally this plant maintained an efficient private fire brigade and had a complete and well designed system of private fire protection, laid down under expert American advice, and comprising pumps, mains, thirty-two hydrants, electric alarms, etc.

Mexican Cotton Mills and Gins.

A word may be said here about the cotton mills of the republic. As already stated, only the excellence of their "morale" saves them. They are with few exceptions poor physical hazards. The rooms for preparatory processes are not properly cut off from the remainder of the plant, the fire doors mentioned in the insurance policies are nearly all shams, and the few sprinkler systems that have been installed are undoubtedly sub-standard in many respects. It may also be of interest to note that there are two distinct types of cotton gin in Mexico. The old style consists of "adobe" buildings having wooden roofs covered with earth or corrugated iron. The machinery is *wooden*, often on a timber platform, and the engine house and boiler house are commonly under the same roof, as are also the cotton bodegas, though the latter are sometimes detached a short distance. In the new style, the buildings are very similar, but the machinery is wholly of steel and iron, and there is very little internal woodwork. Happily, the new style is slowly ousting the old.

Fire Protection.

In Chile all fire departments are of the volunteer variety, and in a sense fire fighting is looked upon as a sport. The voluntary brigades are composed of the young men of different nationalities,

and it is not difficult to imagine what keen competition there is to be first at an outbreak. Some of the brigades do excellent work, but they are often hampered by faulty water supplies. To take the case of the town of Chillan, already mentioned, there were five companies which shared a two-story station of mixed construction. The corps possessed 1,030 metres of new hose and 970 metres in medium condition; they exercised twice a month and had a combined general exercise once a year. There was a regiment of soldiers stationed in the town, and the men were expected to assist at fires. A new domestic and fire-service water system was being completed at the time of the writer's visit, but previously there had been only a primitive, unsatisfactory and limited-area supply in mains. For fire-extinguishing purposes it had been customary to open sluices in the canal in the Avenida Oriente and to allow the water to flow in "acequias" at the sides of the streets. As a general rule, this meant a delay of about ten minutes after receipt of the alarm.

Conditions in Mexico were different. The "fire-service" of Mexico City was paid for by the municipality, which maintained three fire stations and 74 firemen for the protection of its 15 square miles of territory and its 470,000 inhabitants. Two-thirds of the 74 firemen were permanently on duty in the stations, the remaining third being at their homes on periodical "leave." The three stations were too close together, there being no sub-stations in the suburban districts; and the fire-fighting forces were distributed as follows: 40 men in Station No. 1, with 3,000 metres of canvas lined rubber hose with automatic couplings; 18 in Station No. 2, with 300 metres of hose, and 16 in Station No. 3, with 200 metres of hose. Alarms were given by telephone and were usually received late, as the townspeople were in the habit of trying to extinguish their own fires. The firemen had plenty of spirit, but worked badly, and as an administrative force were quite inefficient. At a fire in an asphalt factory in the city some years ago, the fire chief did not appear, and as the firemen refused to do anything at all without him, no effort was made to save the property. The outstanding need was for a chief trained in one of the large departments of the United States, who, if he had administrative ability, could make a good corps.

In many of the provincial towns there are no fire brigades, or none of any account. Water supplies and hydrants are also frequently conspicuous by their absence. When the writer was in Torreon, that city (of 33,000 inhabitants) had only reached the stage of talking about the possibility of forming a fire brigade, and it had only a few scattered hydrants. The only protection was that voluntarily afforded by the private brigade of a large soap factory nearby. At Monterey, with a population exceeding 90,000, there were four scattered hydrants, and six thoroughly inefficient firemen in charge of one fire station, 80 metres of hose, one chemical engine, four large extinguishers on wheels, some hand extinguishers, one fire escape car, two hose carts and two mules. The private brigade at the brewery previously noted, however, consisted of 36 men, and these men "assisted" the town force.

General Remarks.

Whatever may be said in criticism of Chilean methods of fire protection, there is one respect in which that Republic is far in advance of the United States. *In Chile no matches whatever will light elsewhere than on the box.* In "striking" contrast to this condition of affairs, safety matches are practically unknown—or at any rate unused—throughout Mexico. Worse than this, the Mexicans have an especially pernicious type of match with a head at each end of the stalk!

Electrical hazards, particularly in Mexico, are severe. The conditions in many of the older installations in Mexico City, from the fire prevention point of view, can only be described as shocking. One in every five fires is the result of electrical causes. The writer found it impossible to obtain a copy of the municipal regulations governing installations, but, as far as he was able to learn, they did not amount to much in any case. Many of the contractors are irresponsible and incompetent. Flexible cords are run up and down walls and across ceilings, at times in contact with metal work and in some instances frayed; and they often terminate in undesirable key-socket lamps. Fully 40 per cent of the incandescent lamps in use are of this type. Up to 100 amperes are allowed on single circuits, which is far too much in a city where good work is so rare.

Some years ago the writer drew up a schedule of points to be covered in making inspections of cities—a document which was pronounced by the foreign managers of several British fire companies to be the most complete of its kind which they had seen. It is mentioned because one or two quotations from it will convey a general idea of the conditions which are liable to be encountered. Thus —in connection with *morale*—"Any antagonistic racial feelings?" Under "Fire Brigade"—"Danger of Firemen indulging freely in liquor at fires?" Under "Fire Alarms"—"Any absurd police or other regulations?" Under "Police"—"Any bad feeling between Police and Fire Department?" Under "Justice"—"Corrupt or otherwise?" Stated in this bald way and viewed from a distance, these questions have a suggestion of comic opera; but so perhaps would other questions that might be framed by some Chilean or Mexican enquirer in the light of some recent revelations regarding (say) politics in fire departments, or public apathy in regard to hose coupling standardization in the United States.

That Alley of Yours Where Fires Start.

This Alley in Wilmette, a suburb of Chicago, is typical of the unpaved alley everywhere.

Another view of the alley above photographed from the same spot after improved with concrete. What better example could be had of cleanliness and sightliness?

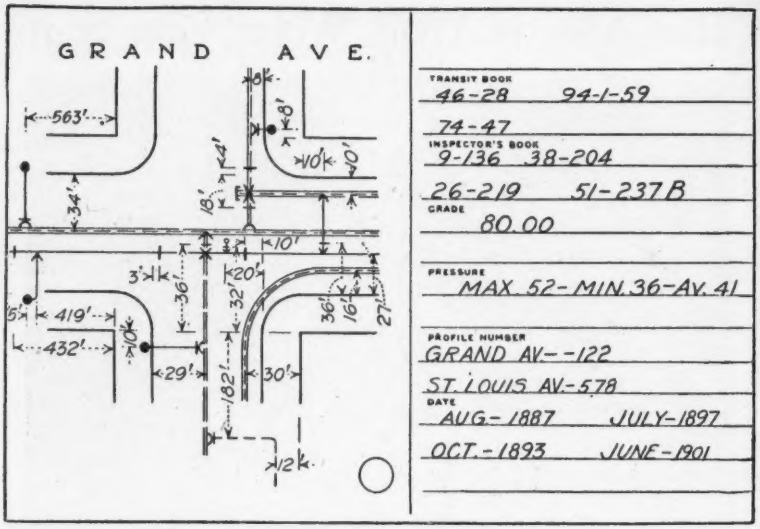


Fig. 1. Reproduction of card used in St. Louis City Water Department.

Fire Service Connections, etc., Recorded by Card Index.

Any card system of keeping records which has proven its value by twenty years and more of continual use, without radical change, is worthy of notice. In this class falls the card system for recording the location of water mains, valves, connections, fire hydrants and other special fixtures, which is in use by the Water Department of the City of St. Louis. This system comprises the use of specially printed 4x6 cards kept in drawers and referred to ordinarily only by members of the office force of the distribution system. The accompanying illustration gives a very clear indication of the nature of the card and the information kept on it. Each size of pipe and each particular fitting has a special symbol, and the situations of all valves are marked, showing their position with reference to the curb or building line.

The street running from bottom to top is an east and west street, and from left to right, a north and south street. The east and west streets follow each other alphabetically in the drawers; that is to say, Atlantic Ave. would come before West Ave., and all intersections with north and south streets are represented by succeeding cards which start from the most easterly intersection of the east and west street with a north and south street. Therefore, to locate any inter-

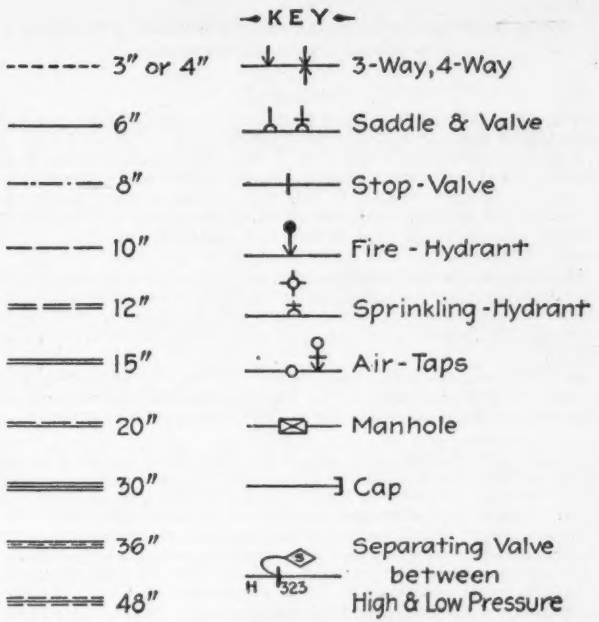


Fig. 2. Key to symbols on card on opposite Page.

section it is necessary only to know which of the streets is an east and west street.

Each card is inclosed in an envelope of transparent paper, which keeps it from being soiled by the rather excessive handling to which cards of this sort are subjected. It is only possible to take the cards from the drawer by unlocking a special keeper-rod, the key to which is guarded carefully and is never allowed to leave the possession of the chief draftsman of the water department.

Smoking in Factories in New York State.

The regulation of smoking in factories in the State of New York is no longer left to the untrammeled discretion or indiscretion of individual employers: it has been taken in hand by the State Industrial Commission. It is understood that efforts are being made in other parts of the country also to secure legislation in regard to this important matter, and the rules adopted by the State Industrial Commission of New York will therefore probably be of more than usual interest to many of our members. The Rules are as follows:

Rules Relating to Smoking in Protected Portions of Factories or in Special Classes of Occupancies.

RULE 15.

Definitions.

The term "incombustible," as used in this rule, means articles, goods, wares or merchandise which will not support combustion.

The term "non-inflammable," as used in this rule, means articles, goods, wares or merchandise which will support combustion but which will not readily burn.

The term "contents," as used in this rule, means articles, goods, wares and merchandise, packed, stored, manufactured or in the process of manufacture.

The term "approved," as used in this rule, means approved by the Industrial Commission.

(a) Smoking may be permitted in a factory only upon written application by an employer, and after the issuance of a permit by the Industrial Commission. The permit shall state the conditions under which, and the place or places in such factory where smoking may be permitted, and shall be posted in a conspicuous place in the factory.

(b) Smoking, as provided in subdivision (a), may be permitted in cigar and cigarette factories for sampling, testing and experimental purposes, provided the factory building is fireproof or equipped with an approved automatic sprinkler system.

(c) In cigar and cigarette factories, other than those specified in subdivision (b), smoking, as provided in subdivision (a), may be permitted for sampling, testing and experimental purposes, in offices, sample rooms and separate rooms provided for that purpose and constructed as defined in subdivision (d).

(d) Offices, sample rooms and separate rooms in which smoking is permitted, except as otherwise prescribed in this rule, shall be enclosed by partitions of fireproof or fire-resisting material; provided, however, that smoking may be permitted in offices, sample rooms and separate rooms constructed of other than fireproof or fire-resisting material, if there shall be installed therein an automatic sprinkler system approved for this purpose. Manufacturing shall not be carried on in the offices, sample rooms or separate rooms provided for the purpose of smoking.

(e) In cigar and cigarette factories where less than six (6) persons are employed at manufacturing, smoking, as provided in subdivision (a), may be permitted for sampling, testing and experimental purposes, and the provisions of subdivisions (b), (c) and (d), as to structural conditions shall not apply.

(f) Smoking, except as otherwise prescribed in this rule, may be permitted, as provided in subdivision (a), where conditions are substantially as follows:

1. In buildings of fireproof construction where the contents are either non-inflammable or incombustible.
2. In buildings of mill construction where the contents are incombustible.
3. In factory buildings other than those specified in subdivisions 1 and 2, if in separate rooms set apart for the purpose and constructed as defined in subdivision (d).
4. In foundries and forge shops.
5. Smoking shall not be permitted in any tenant factory building which is not fireproof and equipped with an approved automatic sprinkler system, except as specified in subdivisions (b) and (c).

(g) In factory buildings or protected portions thereof in which smoking is permitted, there shall be provided fireproof receptacles in which shall be deposited all waste paper and other inflammable waste materials.

(h) No permit shall be issued for smoking in any building, or the premises connected therewith, where explosives, as defined by subdivision one of section 230 of article 15-a of the Labor Law, are manufactured, used or stored.

(i) Where smoking is permitted, the use of celluloid eye-shades or cuff-protectors, or any devices of similar nature, is prohibited.

(j) Portions of any factory where smoking is prohibited, shall be posted as provided by subdivision three of section 83-c of article 6 of the Labor Law.

Piping in Textile Mill Departments.

By Radial.

Courtesy of *Textile World Journal.*

The piping in textile mills is a much more important item than is commonly supposed. In making this statement the writer refers only to the large amount of piping required in textile operations. It is impossible even to estimate the cost of losses in operation, due to the unsuitable and poorly arranged piping found in many mills. There is a woolen mill that has lost $100,000 in waste of fuel in the last ten years for want of a good piping job; but that is not the subject of the present article, although it might properly be a subject for the attention of fuel conservation committees. This discussion is confined to the extent of piping, types and sizes, fittings, and suggestions that may be useful to the engineer or master mechanic. It will not be of great assistance in the absence of a competent engineer or master mechanic, except on repair jobs, and competent engineering advice should be obtained for important new installations or reorganizations of piping work.

Importance of Piping.

In numerous installations of heating and sprinkling the writer has found the cost of piping to amount to 10 per cent. of the cost of the building. In dry rooms this cost will frequently be increased and sometimes will run as high as 15 per cent. of the building cost. The percentage of course will run over 10 per cent. in dyehouses and bleacheries as quite a large amount of piping and numerous valves are used on the different machines. It is common for some machines to have four different lines of piping in connection with their operations, including hot and cold water lines, steam to closed coils and an open steam line.

Any piping plans should receive a very close examination at the hands of someone that keeps posted on the advances in piping engineering. The writer does not believe in sending plans of buildings to different piping contractors and asking for prices on complete and guaranteed systems. The highest bidder will most likely have the best and most economical system, but is likely to be rejected in favor of a competitor who puts in a lower bid for an inferior system.

All kinds of piping are used in textile mills and some of the principal uses for different kinds are as follows:

Wrought iron pipe for heating, sprinkling, water, caustic and steam lines.

Cast iron pipe for water mains and toilet waste lines.

Galvanized pipe is used on humidifying installations and also for sprinkler lines in dyehouses.

Lead lined wrought iron pipe is used for chemic lines.

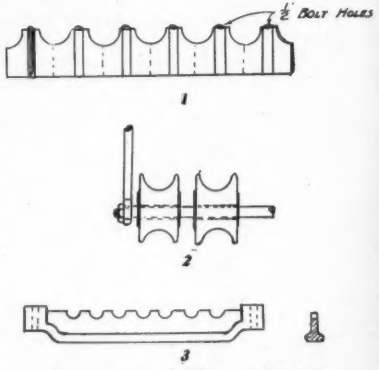
Lead pipe is used extensively in bleacheries for chemic and acid lines.

Heating Systems.

The high pressure systems of steam heating are rapidly being supplanted by low pressure installations with a vacuum in the return lines. In numerous old mills high pressure systems are still in vogue, but to change these over where pipes smaller than 1¼ inches are installed would cost as much as the installation of a new system. The upkeep of the high pressure system is higher owing to frequent renewals of valves and repairs to leaking joints. The brackets will frequently be injured by operatives turning the steam on too quickly. When high pressure coils are set close to the walls or ceilings the paint will blister and become discolored in a very short time.

With the vacuum system kept in good order the coils will not become water clogged and a room can be kept at an even temperature. The principal points to be considered in heating systems are suitable sized feed lines, sufficient radiating surface and best location of same to suit the type of building, efficient traps and suitable sized return lines.

A vacuum from ten to twelve inches will always keep the coils free from air and water. The return lines should always be piped so that the condensation will flow to the pump by gravity. A valve should be placed near the pump so that the return water can be run off. This valve will be required when any work is to be done on the pump.



Figs. 1 to 3. Ceiling coil hangers.

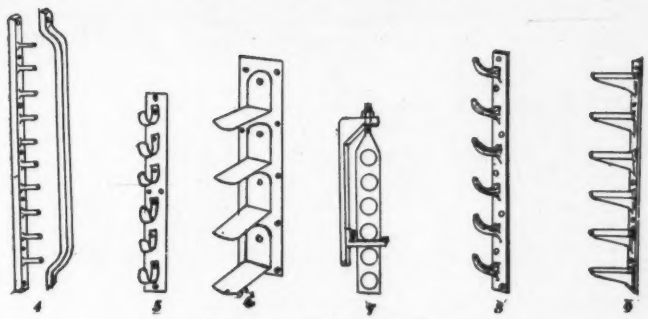
Ceiling Coil Hangers.

Ceiling coil hangers are shown in Figs 1, 2 and 3. Fig. 1 shows a hanger made of strip steel welded together. They are made in 1¼ inch size and the strips can be bought in ten-foot lengths. They are easily cut at the place indicated by the dotted line and can be used for any number of branches. Extra hanger bolts can be inserted where necessary.

Fig. 2 shows a simple type of ceiling coil hanger. The spools are of cast iron. Patterns can be made and hangers for various sizes of pipe can be built up at a moderate cost. The rolls are free on the rod and roll when the pipes expand. The hook bolt is used on the ends.

Fig. 3 shows a good type of ceiling hanger which is extensively used. It is made of cast iron and gives good service.

There are numerous types of wall brackets and Figs. 4, 5, 7 and 8 show those commonly used. Corner brackets or expansion plates are shown in Figs. 6 and 9.

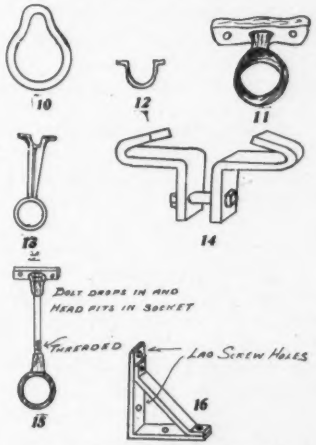


Figs. 4 to 9. Wall coil hangers.

Fig. 4 shows a cast iron wall bracket on which the part at the right is screwed on over the pins. This bracket can be bought in any size. Fig. 5 shows a steel type of wall bracket, and Fig. 6 is the type of expansion plate used with it. They are bought in strips ten feet long and can be cut to suit the number of branches.

Fig. 7 shows a type of adjustable wrought iron hanger, but it is not as suitable as the other types. The steel types are hard to get at the present time owing to the large demand for steel for war purposes. The cast iron hangers can be procured at short notice and are being extensively used.

Figs. 10 to 16 show different styles of pipe hangers used in installations. There are numerous other styles, but those shown are the ones most commonly used. In detail, Fig. 10 is a malleable iron ring; Fig. 11 is made of galvanized iron, and Figs. 12 and 13, cast iron. Fig. 14 shows an I-beam clamp; Fig. 15, an adjustable sprinkler branch hanger, and Fig. 16 a hanger for pipes run along walls.

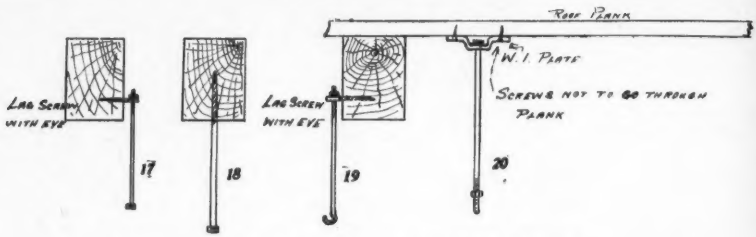


Figs. 10 to 16. Different styles of pipe hangers.

Non-Corrosive Material.

There is a new kind of pipe and fittings, recently put on the market, which is made of a non-corrosive metal. It is very hard and all joints are ground. There should be a good opening for this material in bleacheries, as it has been well tested out.

Figs. 17 to 20 show the common method of holding ceiling coils. Care must be taken that the screws in Fig. 20 do not go through the plank, as there will be danger of the roof leaking later on. Fig. 18 shows a lag screw and Fig. 19 a hook bolt.



Figs. 17 to 20. Bolts used with ceiling coil hangers.

Coupling Lines.

The styles of connecting pipes shown in Figs. 21 and 22 are both extensively used. That shown in Fig. 21 makes a good appearance, but there is more trouble in selecting the correct lengths of pipe. The cleats and hangers will often have to be spaced differently as in a large coil of ten or twelve branches the couplings extend for a distance of thirty inches or more. It is the writer's opinion that Fig. 22 is the better method. It looks neat and the space occupied by the couplings can be confined within eight inches. This will allow the cleats to be spaced a standard distance apart. Right and left elbows and couplings are used for the final connection on the coils when being installed. The right and left coupling gives the least trouble.

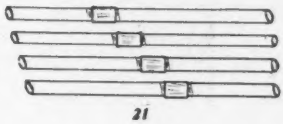
Laying Underground Lines.

All underground sprinkler mains and water service pipes are usually of cast iron when the larger sizes are used. The smaller service pipes, below three inches, should be of galvanized iron. Cast iron pipe has been found in good condition after being used as a water main for seventy-three years. Black pipe steel or wrought iron would not be likely to last more than twenty to thirty years.

Steam pipes when it is necessary to run them underground, are encased in cypress boxes or tile pipe. The writer uses the latter method with good results, the feed main, return line and tile pipe being laid at the same time. The steam main is also covered with 85 per cent. magnesia covering. When lines are run from building to building the tile should have a down grade and should any water get through the cemented joints it can find a ready outlet. A large mill recently had occasion to run a line from a pond to a condenser. This line was made of tile pipe with a patented joint. It has so far proved successful in every way.

Pipe is used in all sizes. The sprinkler yard main may run up to twelve inches in diameter, but from 80 to 90 per cent. of the pipe used in mills will be under six inches in diameter. On hydraulic presses and damask calenders some double extra heavy pipe is used, but this is only in the half-inch sizes. Strong pipe is required, however, owing to the heavy pressure carried on these calenders.

Too much stress cannot be laid upon the subject of properly

attaching valves. When lead or pipe joint grease is used it is recommended that it be put on the pipe end and not in the valve, as when the steam is turned on this stuff is carried to the bearing parts of the valves, and owing to its sticky nature, catches and holds grit and scale on the seats and discs of valves, to their great detriment.

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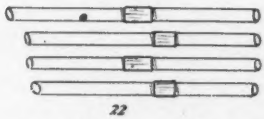
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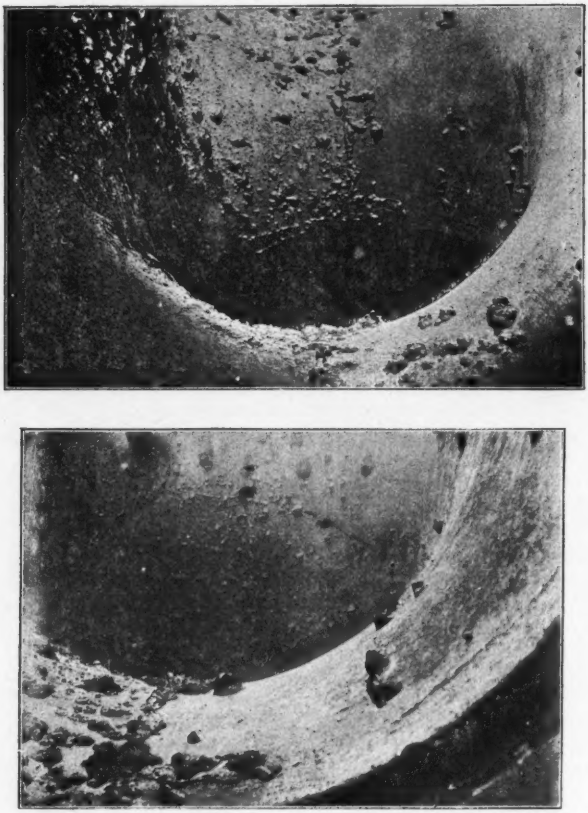
Figs. 21 and 22. Styles of coupling lines.

A bad practice sometimes followed in screwing pipe and brass valves together is in using extra long pipe tongs or wrenches and placing them on the hexagon farthest from the pipe end which is being connected. When this is done, no matter how heavy the valve body may be, it will tend to spring the seat and place same out of line. In screwing onto pipe always close the valves tight, so as to make them as rigid as possible. Use a moderate size wrench and place it on the hexagon of the end that is being attached.

Importance of Cleaning.

Piping should be cleaned out before being screwed into position, and if possible the line should be blown out after the valves are in place. Unless this is done loose scale or metal chips remaining in the pipes may injure the seats or discs, causing leaks and necessitating re-grinding, reseating or removal of the discs. A valve should not be allowed to carry the weight of a line of piping as this may spring the seat. A hanger properly placed has sometimes remedied the trouble of a leaky valve, which could not be kept tight before the use of the hanger.



Courtesy of Prof. Gardner S. Williams and John Wiley & Son, Inc.

Fig. 1. Tubercles growing in iron water pipes taken from a cross in a 30-inch main.

Tuberculation, Incrustation and Sedimentation of Water Mains.

By **Edward H. Keith,**
(Member N. F. P. A.)
Resident Engineer, Rochester, N. Y., The Underwriters' Bureau of the Middle and Southern States.

With the present tendency to lower insurance rates and the constantly increasing number of Automatic Sprinkler Equipments, it is becoming more and more a matter of vital importance that the water supply for the fire hydrants and the Automatic Sprinkler Systems, especially in the congested districts of our large cities, should be adequate to properly take care of the extinguishing of a fire.

Fig. 2. 12 inches of sediment in 20-inch main.

Next in importance to the care and maintenance of property, the water supply is the backbone of our fire protection (the Fire Department, of course, being a necessary factor).

It is therefore essential that we should be familiar, not only with the character of the water supplies, but especially with the condition of the distributing system of water mains.

It is also coming to be more generally recognized that some provision should be made for a frequent examination of these mains. Too often the water mains are left to take care of themselves, after they are once buried, and they lie in the ground, year after year, without attention until it is found that the cost of pumping has increased abnormally or that the pressure is inadequate at some large fire. An investigation brings out the fact that the mains are clogged with sediment or incrusted with tubercular rust, etc.

To most water departments the condition of the interior of the mains has been unknown because of the necessary expense entailed in digging down and cutting into the pipe.

Someone has well said that "the modern city is as dependent on its water mains as we are dependent upon the arteries, veins and capillaries in the human body." If the arteries and veins, etc., in the human body become clogged, it is a difficult matter to relieve their condition, but if the water mains become clogged, it is easy, though expensive, to have them cleaned out by flushing or scraping or by having some cleaning company remove the obstruction with their patent machinery. This cost could be materially reduced if, when the mains had been laid, some provision had been made for their examination by the introduction of some such contrivance as a "hatch box" at street intersections or at other definite places and located in pits easy of access. In this connection it might be well to suggest that all gate valves at street intersections and in connec-

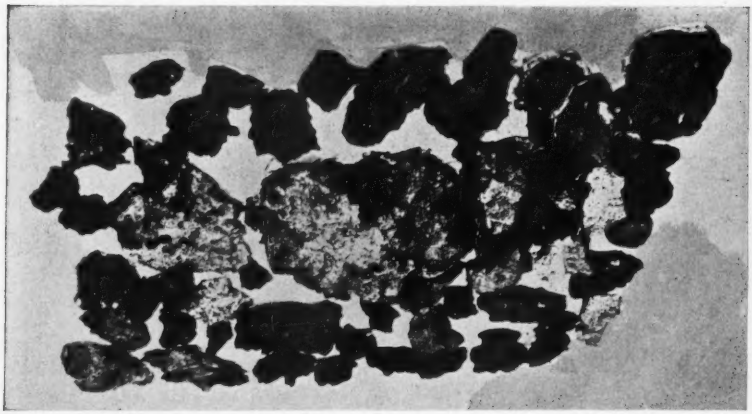


Fig. 3. Group of tubercles or rust nodules.

tions to sprinkler systems and fire services should be placed in accessible pits for ease of inspection and for packing of stuffing boxes, etc., so as to avoid the necessity and expense of opening up the street whenever a leak occurs.

When conduits are placed under ground for the reception of electric wires, pits are provided at frequent intervals, not only for ease in introducing the wires, but also to facilitate frequent tests and inspections. Were similar arrangements made in the case of water mains, frequent inspections could be made without the expense and annoyance of digging up the streets, as is so often found necessary at the present time, and the appalling condition recently found in Rochester, N. Y., in a 20-inch main would have been avoided. This main contained twelve inches of a heavy clay sediment which reduced the carrying capacity of the main 50 per cent and decreased the cross section area 75 per cent. It had been in service for 45 years, and was supplied by water pumped direct from the Genesee River. (Photo No. 2.)

The history of water mains from the time of the old wooden pipes, bored out from logs, to the present coated cast-iron and steel mains has been a history of trouble from various causes. For years it was thought that nothing could be done to alleviate the difficulties caused by obstructions in the mains; mains that had become obstructed by rust or sediment were abandoned and new mains were laid.

In recent years, however, the task of removing the various kinds of obstructions has been accomplished, and thousands of miles of mains have been successfully cleaned in all parts of the country. The attempts at cleaning were at first crude, but after many experiments new methods were tried, and today there are concerns who make a business of restoring clogged mains to their former condition.

Fig. 4.

Fig. 4a.

Examples of Incrustation.

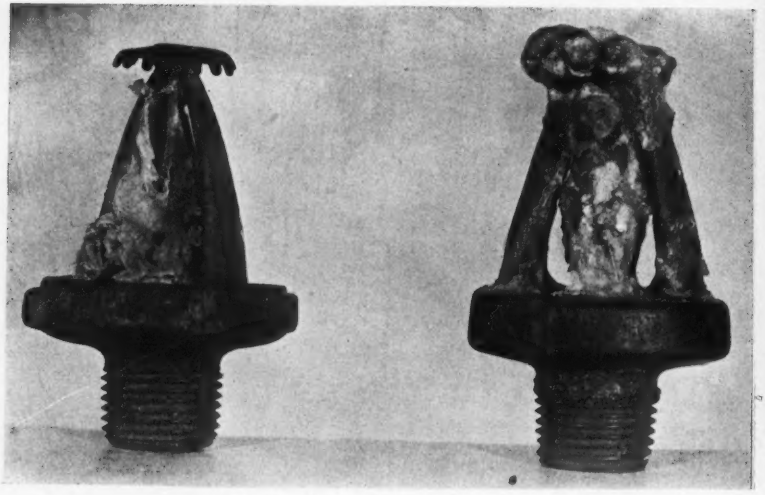
For convenience, the obstructions found in water mains may be separated into two classes, viz:

1. **Incrustations.**
   - (a) Due to tubercular corrosion or rust.
   - (b) Due to the chemical constituents of the water.
   - (c) Due to growths, biological or living organisms.

2. **Deposits.**
   - (a) Sedimentary (mud, clay, leaves or vegetable decay).
   - (b) Foreign matter other than sediment.

It may be well to emphasize the difference between *incrustations* and *deposits*. Incrustations may be due to tuberculation or rust formed by the corrosion of the iron, or they may be due to the deposition of the salts of calcium or magnesium, etc., in water containing large amounts of mineral matter in solution. Incrustations also result from certain biological reactions produced by organisms found in every water supply. In contradistinction to incrustations, sedimentary deposits often occur in pipes, and consist of mud, clay, dead organisms, etc. Their deposition is mechanical, due to sedimentation and identical with the process effected in reservoirs or ponds. The flow of water is obstructed by both the incrustation and the deposit. Deposits, however, are in the bottom of the pipes, and are usually of softer material and more easily removed,

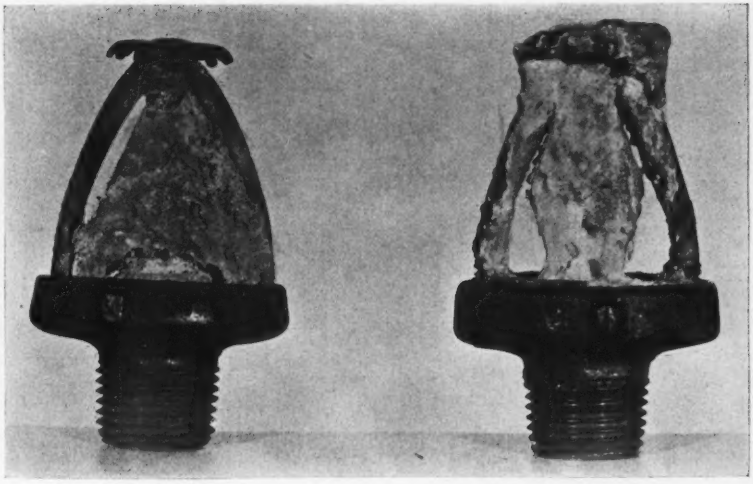
Fig. 5. Tuberculation.



Figs. 6 and 7. Incrusted Sprinklers.

and the loss of carrying capacity is the result of a reduction of the area of the cross section of the pipe. Incrustations usually completely line the interior of the pipe, causing a gradually restricted diameter which reduces the carrying capacity and at the same time causes a frictional loss due to the nodular form of many of the incrustations. These nodules may be separated by an appreciable distance (see illustration at beginning of this article), and cover only a small percentage of the interior surface of the pipe, not exceeding one-sixteenth inch, or one-eighth inch in height, and still cause a marked decrease in delivery.

As a practical illustration of the seriousness of tuberculation or incrustation of the inside surface of a water main, the interior of an incrusted or tuberculated main may be compared with the bottom of a ship covered with barnacles. It is a well-known fact that ships whose bottoms are thus covered with a thickness not exceeding one-quarter inch have to be thoroughly scraped, as the rough surface of the barnacles creates so much friction, when the ship is moving through the water, that the speed of the ship is greatly decreased. In the case of the water mains, the water is the moving body and the side of the pipe is stationary; in the case of the ship, the water is stationary and the side of the ship is the moving body, but the effect is identical. In both cases the result is increased friction due to roughness. If the impaired efficiency is so great in the case of a ship which is only a few hundred feet long, what must be the decrease in efficiency in water mains that are miles in length? In the case of the ship the increase in power required from the engines to maintain a proper speed makes the cost of operation much higher, and similarly the increased power required of a pumping engine in



Figs. 8 and 9. Incrusted Sprinklers.

order to maintain a proper delivery of water through the mains makes the operating cost of a waterworks plant much higher. The effect of tuberculation in water mains, as in the case of barnacles on a ship, not only affects the movement, but also increases the operating cost.

1. Incrustation. (a) Tuberculation.

What is tuberculation? There have been many theories advanced, and some of them have been included within the scope of this article. Mr. Nicholas S. Hill, Jr., C. E., once asked this question at a meeting of the American Water Works Association, and Secretary Diven replied that he wondered if Mr. Hill had ever read what General Sherman said about war.

Primarily tuberculation takes place when water comes in actual contact with the iron of the pipe, and could probably be prevented if the iron of the pipe could be effectively protected, by any means, from such contact.

Fig. 10. Incrusted water main.

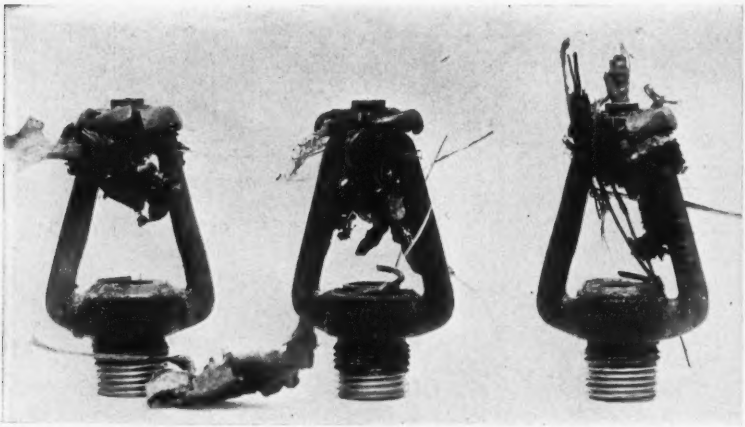


Fig. 11. Leaves on deflectors of sprinklers.

If a piece of coated pipe be examined in the first stages of rusting (see photo No. 3), it will be found that the conicle shaped nodules are formed regularly or irregularly, as the case may be, at those points where the coating has been removed or injured or where for some reason the original coating was imperfectly applied. The tubercles or rust nodules vary considerably in size and appearance, the smaller ones presenting the appearance of blisters, the larger ones resembling cones of various forms from slight growths to cones 1½ inches in height, and from small spots to nodules two inches in diameter and irregular in shape. Sometimes there are several cones on a single nodule, probably due to an abrasion of the surface of the cone and a new growth starting. They are formed in concentric layers, with a hard outside of varying density and a softer inside. In some cases there is a hollow in the center of the cone just above the coating of the pipe, and the nodule or blister is attached by its edges to the pipe.

Dr. J. Campbell Brown (in *Proceedings,* Institute Civil Engineers, Vol. 156) describes the formation of these tubercules or nodules as follows:

> "The central portion of the limpet is black when fresh and soft. It often contains a little sulphide of iron as well as oxide; it becomes red on exposure to the air; the middle layers are of the orange red, ferric oxide, and sometimes contain iron organisms of the well-known rosary form, which a high magnification resolves into a double, ribbon-shaped spiral, twisted closely upon itself. The limpet shaped cones vary in consistency; when well developed they are hard outside and soft within. The outer concentric layers are denser, sometimes quite hard; they are composed of ferric oxides but include hard black layers of magnetic oxide of iron, in which dead organisms can occasionally be found. Many incrustations contain no organisms; but as far as my observations go, when present, the organisms appear to modify the com-

Fig. 12. 4 inches of sediment in 8-inch main.

position of the limpet. The rosary shaped form does not belong to one organism only but it is assumed by different organisms at a certain stage of growth. When it occurs I have always found the usually black iron compound converted into ferric oxide."

The rapidity with which rust or tubercles form and the weight per lineal foot of such formation appears to depend entirely on the local conditions, and varies appreciably in different sections of the country.

The following data was furnished by the National Water Main Cleaning Company of New York:

Location	Size	In Service	Average weight per lineal foot
Springfield, Mo.....	4 inch	10 years	2 pounds 4 ounces
Carrolton, Mo.....	6 "	25 "	1 " 8 "
Huron, So. Dakota.....	6 "	7 "	8 " 4 "
St. Augustine, Fla.....	10 "	17 "	7 " 8 "
Oskaloosa, Iowa.....	12 "	12 "	4 " 12 "
Jackson, Tenn.....	16 "	32 "	20 "

In Rochester, N. Y., the writer found the average weight in pipe that had been in service for 45 years as follows:

6 inch	2 pounds
8 "	3 " 8 ounces
12 "	8 "
20 "	17 "

As to whether tubercles form more rapidly in coated or uncoated pipe there appears to be some question. On coated pipe the tuberculous deposit forms practically from a pin point in the coating, and the tubercles or nodules are found scattered at varying intervals

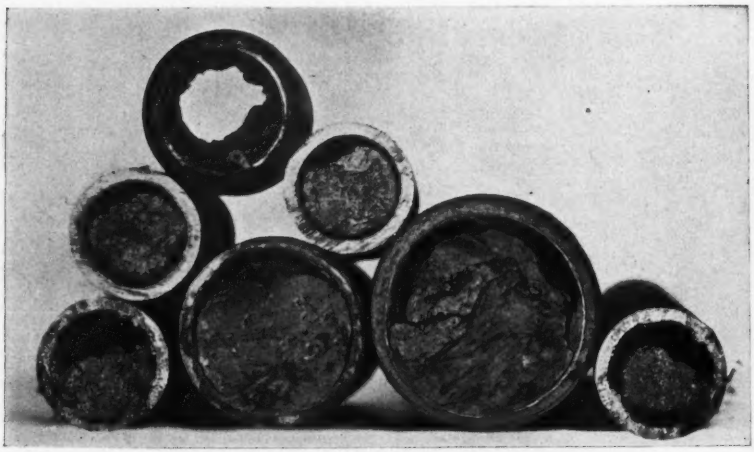


Fig. 12a. Sprinkler pipes filled with sediment.

throughout the interior surface of the pipe, while in uncoated pipe the rusting or tuberculation appears to be more even in its character. It also appears to be an acknowledged fact that tubercles form more rapidly where water flows the fastest.

Tubercles are caused by chemical combination with the iron and one or more of the constituents of the water or its contents, and hence their formation depends on the quality of the water. In general it might be expected that filtered water would cause less trouble of this kind than unfiltered water, but this has not been proven. The presence of acids, particularly carbonic acid, liberated by organisms present in the water, free oxygen and alkalies cause the formation of these nodules.

Both salts and acids in solution favor the formation of the tubercular incrustations, and it has even been found that neutral water may have a similar effect. Soft waters, being more commonly acid, will cause this corrosive action to take place more rapidly than hard waters. Therefore surface waters, being softer than ground waters, can be expected to give more trouble in this respect, the ground waters being usually harder.

Fig. 13. Surplus lead found in 6-inch main, (see page 276)

It would be possible, of course, to treat the water chemically in order to eliminate the above causes, but such treatment would have worse effect than tuberculation. In some cases highly alkaline waters form preliminary deposits which in a measure protect the pipe from further corrosion, but these deposits are in themselves objectionable, as they are the cause of the same losses as other incrustations, although to a lesser degree. It has been noticed that after the tuberculation has reached a certain stage or thickness it takes place less rapidly than before.

While the above statements regarding the causes of incrustations are generally accepted, there are exceptions to all general rules. For instance, in Brooklyn, New York, and in portions of West Virginia, where ground waters are distributed, the incrustation has been exceedingly bad.

Theories of Corrosion.*

"The many experimenters who have investigated this subject have evolved at least three different theories of iron pipe corrosion or tuberculation.

The hydrogen-peroxide theory explains the phenomena of rusting by assuming that when iron, water, and oxygen are in contact a chemical reaction takes place in which ferrous oxide (FeO) and hydrogen peroxide (H_2O_2) are formed. Then the ferrous oxide is supposed to react with a portion of the hydrogen peroxide to form a basic or hydrated oxide; rust, an insoluble basic oxide, is the final product.

A second theory, known as the carbonic acid theory, holds that rusting is always started by an acid. It assumes that even a very weak carbonic acid will first convert a portion of the iron into a ferrous salt, with the escape of hydrogen. Under the influence of oxygen and water the ferrous salt is oxidized to ferric hydroxide ($2Fe(OH)_3$). The ferric hydroxide is insoluble and upon precipitation the original carbonic acid is liberated. The carbonic acid is then free to attack more iron and to repeat the process of reducing the iron to rust.

The third and perhaps the most important theory of iron corrosion is known as the electrolytic theory. It rests on the assumption that when water comes into contact with an iron surface a certain amount of the iron goes into solution. This small amount of iron carried in solution in the water produces an electrolyte. The process of rusting is then explained by the familiar galvanic electrolysis which takes place between the points of high and low potential on the surface of the metal. The modern conception of the reactions which take place holds that they are accompanied by certain readjustments of the electrical state of the reacting ions and the iron must go into solution as a ferrous ion before it becomes oxidized.

If it were possible to summarize all of the painstaking research that has been carried on by investigators since 1800, we would probably find that one common point has always been mutually agreed upon. It has always been admitted that the iron particles must be in direct contact with oxygen and moisture before rusting can take place. In all likelihood, it is probably close to the truth to say that under varying conditions of service for iron pipe, any one or all of the corrosion theories actually apply during the process of rusting. As for inhibiting or preventing the rusting of an iron pipe line, the problems, both theoretical and practical, seem to sum up in the one proposition of keeping moisture and oxygen from reaching the iron itself. Expressed in different terms it is the old question of getting a protective coating on all exposed parts of the pipe."

*From article by Harry Y. Carson, in *Journal of the American Water Works Association*, Vol. 4, No. 2, June, 1917.

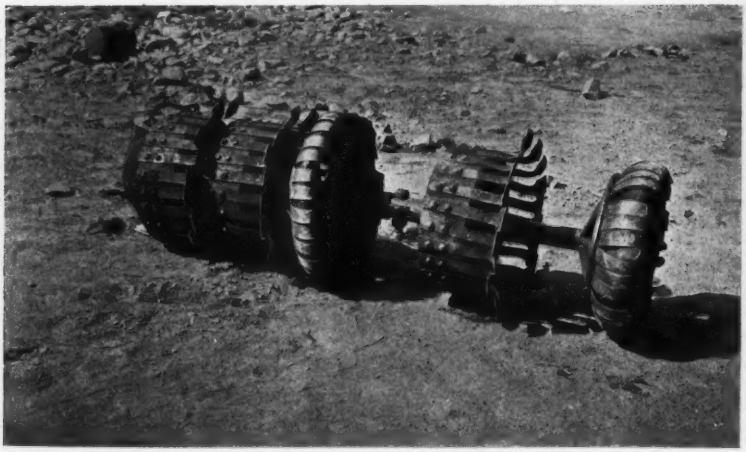


Fig. 14. Go-Devil, 16-inch size.

(b) Chemical Constituents of the Water.

Some waters are impregnated to a more or less degree with various salts of calcium, magnesium, etc., and these salts, under certain conditions, are deposited on the sides of the pipe in the form of carbonates covering the entire inner surface, and gradually decreasing the inside diameter of the pipe until it is nearly, if not completely, clogged, and little or no water can pass through. (See photos 4 and 5.)

This is the most difficult form of obstruction to remove on account of its hardness and the compactness of the incrustation. It has, however, been successfully removed in some of our western cities.

An instance that came under the observation of the writer illustrates the seriousness of using water for sprinkler systems that is highly impregnated with mineral salts. The water supply for a sprinkler system located near Syracuse, N. Y., was pumped from a driven well into a large gravity tank on the top of the building, and had been in service for a number of years. At one of the inspections of the property in question, an incrustation was noticed on the fusible links of some of the pendant sprinklers and also on the deflectors. (See photos 6-7-8-9.) That was at first thought to be the work of mud wasps, but on closer inspection was found to be a mineral deposit which a chemical analysis proved to be salts of calcium and magnesium. On account of a slight leakage in the seat of the sprinkler the water had seeped out, evaporating almost immediately, and gradually forming a deposit or incrustation on the link and deflector. (A number of these sprinklers were removed and tested in the Laboratory oven, and proved to be inoperative.)

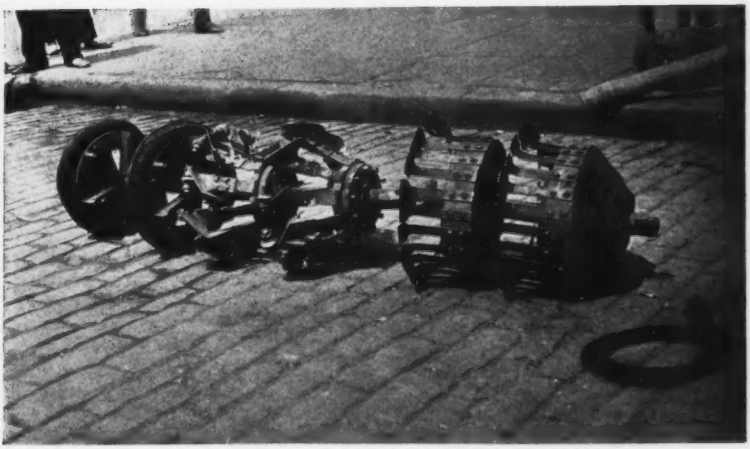


Fig. 15. Go-Devil, 12-inch size.

In another case, in the same plant, where a 4-inch cast iron underground main passed near a steam pipe, it was found after the main had been in service for a number of years that it was impossible to obtain water on opening the sprinkler drain, and on removing a section of the pipe it was found to be completely filled with incrustation (see photo No. 10), which on analysis proved to be about 95% calcium salts, with some iron rust and some silica of sand, 85%-90% being calcium carbonate.

(c) Growths, Biological or Living Organisms.

Growths, Pipe Moss, Sponge, etc. (see article by Nicholas S. Hill, Jr., on the "Flow of Water in Pipes," in *Proceedings*, American Water Works Association, June, 1907.)

This biological phenomenon **(a) Pipe Moss,** is an animal form known as bryozoa, also called polyzoa, which means many animals, for it is composed of many individuals united in a common stock, and forms moss-like aggregations which frequently attain a considerable size, and are found attached to submerged objects. In form they vary greatly, forming branching tree-like colonies, some spreading out in flat sheets over the surface of submerged objects, while others form soft, moss-like sheaths. The bryozoa increase by the process of budding. Eggs form within the body of the animal and escape after death of the parent.

The coating or growth developed by these bryozoa in pipes occurs in branching interlaced filaments, which take the direction of the flow of the current, as well as a brown matting covering large areas to a considerable thickness. This matting has a rough surface and appreciably diminishes the flow, and when dried resembles a piece of coarse burlap. If for any reason there is a change in the direction of the flow of the water in the pipes, this pipe moss breaks

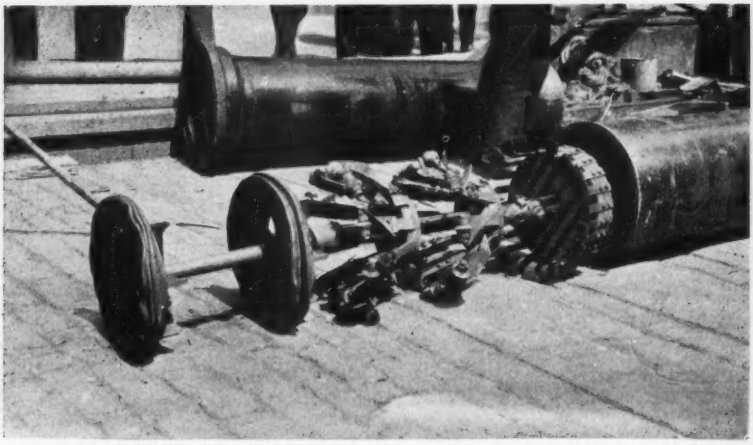


Fig. 16. Go-Devil, 12-inch size, partially inserted in new section of pipe.

off and sometimes causes serious obstructions in the smaller pipes. Mr. Whipple (*Proceedings*, American Water Works Association, 1904, page 158) records an instance in Brooklyn, N. Y., where a change in the direction of the flow of water broke off the filament of the organisms attached to the walls of the main, and the network passed down the mains and lodged in a 2-inch service pipe, causing the collapse of two boilers. The writer has found a number of instances where sprinkler alarm valves have been clogged and rendered inoperative by this pipe moss.

(b) Sponge. These are really animals, and lay eggs which float with the water and attach themselves to the interior surface of the pipes. These sponges grow very rapidly, and do not thrive in quiet water. They are firmly attached to the objects on which they rest, and are seldom found face upward, but are usually found submerged with face downward, usually on the top and sides of the pipe. The eggs of the sponge mass themselves in traceries, like lace work, on the surface of the pipe, varying in size, and the exterior boundary takes a circular or oval form. In time the eggs bring forth sponges, which grow in patches. This growth, if undisturbed, gives out long fingers of sponge, which hang down across the pipe like a trellis or net, and effect a serious retardation of flow.

2. Deposits.

(a) Sedimentary Deposits. These are not the result of chemical action, but are caused by the sedimentation of foreign or suspended matter. Sedimentation usually takes place at low points or where the flow is not sufficient to carry along the suspended particles of clay, mud or dead organisms. It has been found that river waters which are at times oily usually give more troubles of this kind than those from other sources.

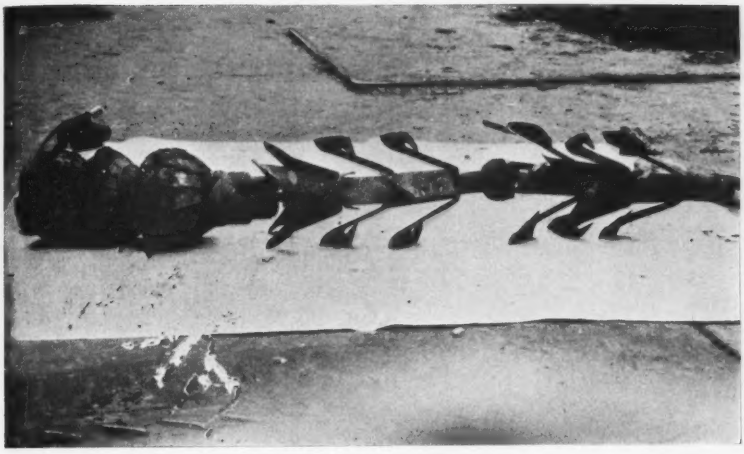


Fig. 17. Go-Devil, 6 and 8-inch size.

This deposit varies from a soft mud to a heavy, sticky clay, according to the character of the country through which the river or stream flows, and at times contains large quantities of leaves and dead organisms. These leaves, etc., unless removed by screens, are a constant menace to the automatic sprinkler systems, and especially to the operation of the sprinkler alarm valves.

An instance of this kind happened recently when a fire occurred on the top floor of a six-story clothing factory. Several sprinklers operated and extinguished the fire, but through the failure of the sprinkler alarm to operate, and there being no watchman on the premises, the sprinklers discharged water all night, thoroughly drenching the stock on all floors. This condition was not discovered until early in the morning, when water was seen flowing from under the door of the building into the street. On investigating the fire the next morning, the writer noticed an accumulation of leaves on the deflectors of most of the sprinklers that had operated (see photo No. 11), and the inside of the pipe at the sprinkler orifice was also found to contain an accumulation of leaves. On examining the screen at the rotary gong, no leaves were found, but some were found in the alarm valve chamber which had prevented the water from operating the rotary gong.

The writer has made extensive investigations into the matter of mud and clay in water mains supplied by both reservoirs and direct pumping from rivers, and the most serious conditions have been found where water was taken from rivers without filtration. In some instances 8-inch mains have been found half full of sediment (see photo No. 12), and 20-inch mains have been found filled to within eight inches of the top, thus reducing the cross section area 75% and the carrying capacity 50% (see photo No. 2). The former main

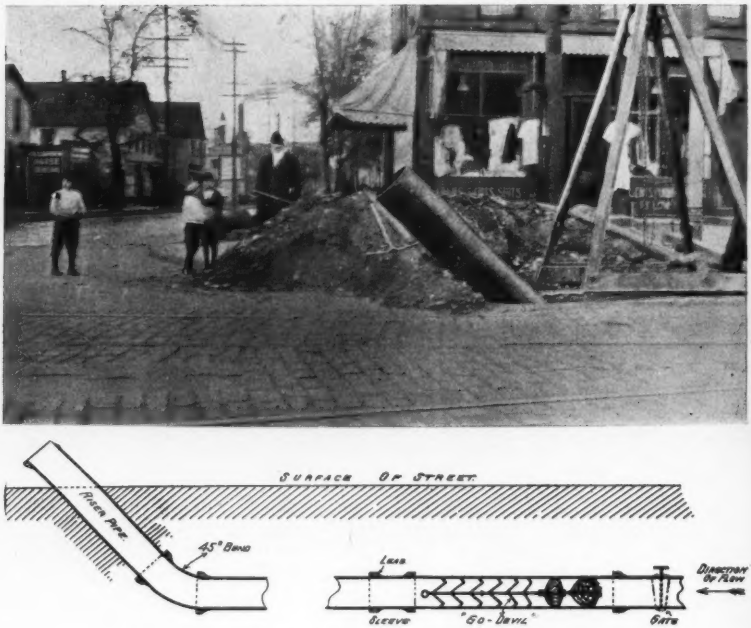


Fig. 18. Illustration of riser pipe and "go-devil" in main.

had been cleaned about eight years previous, when it was found in practically the same condition. The latter main had been in service 45 years, and had never been cleaned. It is quite probable that this main had been in this condition for years and that it would not fill to a greater depth because the increased velocity through the restricted opening was sufficient to carry along the sediment and prevent a further accumulation and thus maintain the 8-inch free water way.

The sprinkler piping in a large number of the older sprinkler systems supplied by this river water have been examined, and were found more or less completely filled with sediment (see photo No. 12), which rendered their operation slow or doubtful.

(b) **Foreign Matter Other Than Sediment.** In this class may be included surplus lead, which finds its way into the mains when the joints are being calked, through faulty yarning at the joints. The writer has found as much as 40 pounds of lead in one piece in the bottom of a main that was being cleaned. In one instance a piece two inches thick, weighing 29 pounds, was found in a 6-inch main. (See photo No. 13.) The calker had used 37 pounds of lead to calk a joint that normally required only eight pounds, and through his carelessness had reduced the main at this point from a 6 to a 5-inch main.

Fig. 19. Go-Devil shooting out of riser from 20-inch main.

In another instance a bundle of laths was found. Crow-bars, pick-handles, stones weighing several pounds, and various other obstructions have been found.

At a recent hydrant test, with 45 pounds normal static pressure, the pressure fell to 5 pounds with a 2½-inch hydrant butt wide open, flowing 417 gallons per minute. On opening up the street and removing the 4-inch lateral supplying the hydrant, it was found filled with stones, one of them 5 inches long, 3 inches wide, and 2 inches thick, and many the size of hens' eggs; these had been in the main for years, as evidenced by the fact that they were cemented to the bottom of the main by tubercular rust. After removing the obstructions and replacing the lateral, a second test was made, and a flowing pressure of 17 pounds was obtained, with a discharge of 746 gallons per minute. The hydrant tested was supplied by a 4-inch lateral from a 6-inch dead-end main. After cleaning the 6-inch main, replacing the 4-inch lateral by a 6-inch and increasing a nearby 4-inch cross-feed main, which was found to be considerably obstructed with rust and stones, by an 8-inch main, a further test was made, and a flowing pressure of 23 pounds was obtained, with a discharge of 894 gallons per minute.

It can thus readily be seen that the causes of increased frictional losses and decreased flow in water mains can be divided into the foregoing classes, but it would probably be impossible to assign many cases to any one of the classes alone, as there might be a combination of two or three, one helping the other to form more rapidly. For instance, after the pipe had first begun to incrust and roughen, foreign matter would find a better foothold and be less liable to be carried along by the flow of water and organic growth would have a better foundation.

Fig. 20. Sediment, etc., discharging from riser pipe.

Cleaning the Mains.

Incrustations, tubercles or other growths and sedimentary deposits may be removed by scrapers drawn through the mains by windlass and cable or by a so-called "Go-Devil" forced through by water pressure.

The "Go-Devil" usually consists of a steel shaft, in several sections, connected by flexible joints, to which are attached steel cutting knives or blades, some of which have saw teeth and some have scrapers, all of them at right angles to the central shaft; there are several sections of these blades, and, behind them, firmly attached to the shaft, are one or more pistons which fit the pipe very closely with leather gaskets held in place by steel springs which are continous around the entire circumference. The function of the saw teeth is to cut up or tear loose the incrustations, etc., that adhere to the sides of the pipe; the function of the blades is to scrape away all of the matter left by the saw teeth; the function of the flexible disc is to deflect the wash water and to smooth the surface and to leave a clear, smooth waterway. The diameter of the machine is a little in excess of the diameter of the pipe so as to keep the machine firmly centered in the pipe. In addition to the above described machine, there are other types having many different types of blades. (See photos Nos. 14-15-16-17.)

The method of procedure in cleaning the mains is as follows: After shutting off the water, the main is uncovered and is opened up in two places and a section removed. The distance between the cuts varies according to the general conditions of the mains, the character and size of the cross mains, the angle of curvature at the bends, etc. A "Go-Devil" or cleaning machine is placed in a new piece of main the same size and length as cut out; this is made up

Fig. 21. Mud left on ground after cleaning of main.

and leaded-in as a permanent part of the main; at the other cut, which may be 100 feet or 5000 feet or several miles distant, a riser pipe, as the same size as the main, is made up and extended to the surface at an angle of 45 degrees. (See illustration and photo No. 18.) When all is ready, a gate valve, near the place where the "Go-Devil" has been inserted, is partially opened, and the "Go-Devil" is shot through and comes out through the riser pipe. (See photo No. 19.) In some cases, instead of shooting the "Go-Devil" by water pressure, it is drawn through by cable and windlass, a steel rope, to

Fig. 22. Sediment, etc., discharged from riser pipe.

Fig. 23. Pile of tubercle scale removed from 6,000-foot length of 12-inch main.

which the machine is attached, having been previously shot through by special carrier.

With either a cable-drawn or water-propelled machine, a certain amount of water is allowed to pass the machine in order to carry ahead of it the dirt and incrustation (see photo No. 23) which has been cut and ground up by the machine, and this sediment and cleanings are carried to the surface of the street through the riser pipe. (See photos Nos. 20-21-22.) After the machine has passed through the main, the water is shut off, the riser pipe removed and the main at this point reconnected and all valves again opened. During the cleaning, all valves in the cross mains are also closed, and men are stationed at the various shut-off gates along the line of the main to be cleaned and provided with telephone receivers to note when the "Go-Devel" passes those points.

In the cleaning of the mains by this method, the coating of the pipe does not appear to be destroyed or injured, and later tests made in various parts of the country do not show that corrosion or tuberculation takes place any more rapidly than before cleaning. Mr. Burt B. Hodgman, in a paper on "The Restoration of Old Distributing Systems," read at the Annual Convention of the American Water Works Association, held in Rochester, N. Y., June, 1911, brings out this point very clearly, and at the same time shows a comparison of the carrying capacity of the mains before and after cleaning.

In conclusion, I wish to thank Mr. J. M. Diven, Secretary of the American Water Works Association, for his courtesy in looking up data and for various reports of the Association; also Mr. Clinton Inglee, Secretary of the National Water Main Cleaning Company, for the loan of a number of interesting photographs of incrusted and tuberculated mains; and Mr. Beekman C. Little, Superintendent of the Rochester Water Works Bureau, whose co-operation was of

material assistance in my investigations. I am also indebted to Mr. Nicholas J. Hill, Jr., for much information contained in his paper on "Tuberculation and Flow of Water in Pipes," from which I have quoted in part; to Prof. Gardner S. Williams I am indebted for the use of the illustrations showing the growth of tubercles in water pipes, which appeared in Hydraulic Tables, by Williams and Hazen, published by John Wiley & Sons, Inc.

Excluding Gasoline from Sewers.

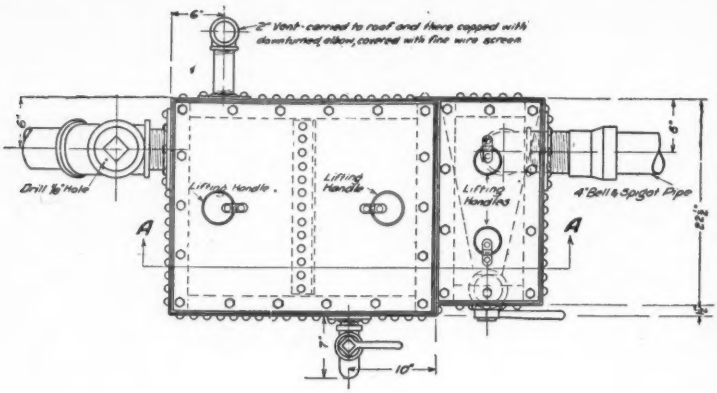
An ordinance of the city of New York requires every garage where more than four motor vehicles are stored to install an oil separator or some similar device, and that this be emptied and cleaned at frequent intervals; the object being to prevent gasoline from reaching the sewers, it having been determined with considerable certainty that such gasoline has been responsible for numerous explosions in sewers. Recently the Board of Aldermen passed an ordinance repealing the ordinance requiring separators, but this was vetoed by the mayor and his veto was sustained by a vote of 24 to 9.

In transmitting his veto, Mayor Mitchell stated that he had asked the sewer bureau and the fire department to report upon the question, and that both had vigorously opposed the repeal of the ordinance. The chief engineer of sewers stated that for three years up to the present there has been much less difficulty than formerly and practically no explosions have occurred, principally owing to the precautions required by the ordinance. In June, 1917, however, an explosion occurred in East 42nd Street, in which manhole covers were blown into the air. On July 23rd an explosion occurred in West 23rd Street, at the river front, in which 12 manhole covers were blown into the air and a number of people injured. The explosion was near the wooden sewer which served as the outlet under the dock, and this was found to be on fire, and had to be partially destroyed before the fire department could get control of the flames. The garage of the Adams Express Co. in 10th Ave. was suspected of being one of the chief sources of the gasoline that caused this explosion. In addition to these explosions, a number of workmen had been made ill by the gas fumes while in the sewers.

The mayor said in his veto that it is possible that oil separators can be dispensed with in outlying sections of the city, but that the safety of the sewer operators who are required to work daily in the sewers, as well as of the citizens in the streets, is endangered by gasoline in the heart of the city and is more important than the inconvenience and expense to garage owners of installing and maintaining the oil separators.

The ordinance requiring the separators has been declared constitutional by the Court of Appeals.

In recent years practically all the large cities have had violent explosions in sewers, the evidence in many cases indicating gasoline or other oil vapors as the cause, and several cities have rigid require-



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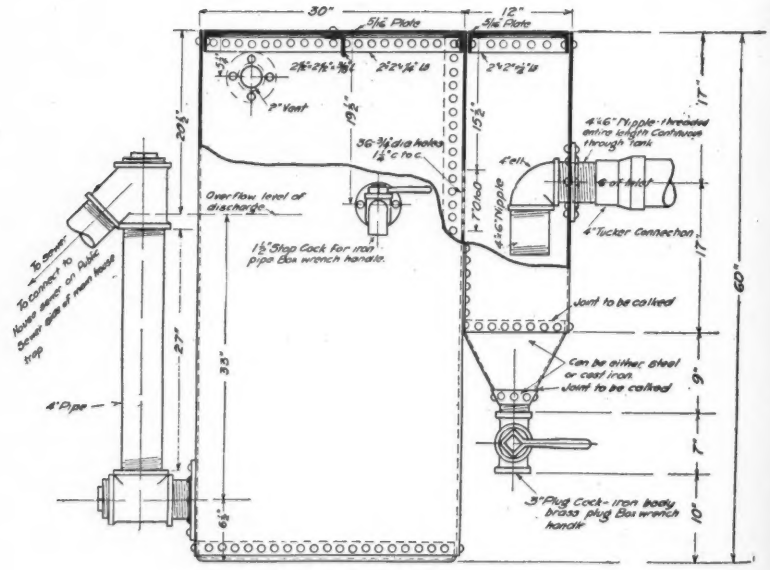

30"
12"
5/16" Plate
5/16" Plate
2" Vent
36-3/16 dia holes 1 1/2" c to c
4"x6" Nipple - threaded entire length Continuous through Tank
4" Elbow
4"x6" Nipple
4" Tucker Connection
Over Flow level of discharge
1 1/2" Stop Cock for iron pipe Box wrench handle
To Street — To connect to House sewer on Public Sewer side of main house trap
Joint to be calked
Can be either Steel or cast iron
Joint to be calked
4" Pipe
3" Plug Cock - iron body brass plug Box wrench handle
69"

SIDE ELEVATION & SECTION "AA"

Plate a. Oil Separator.

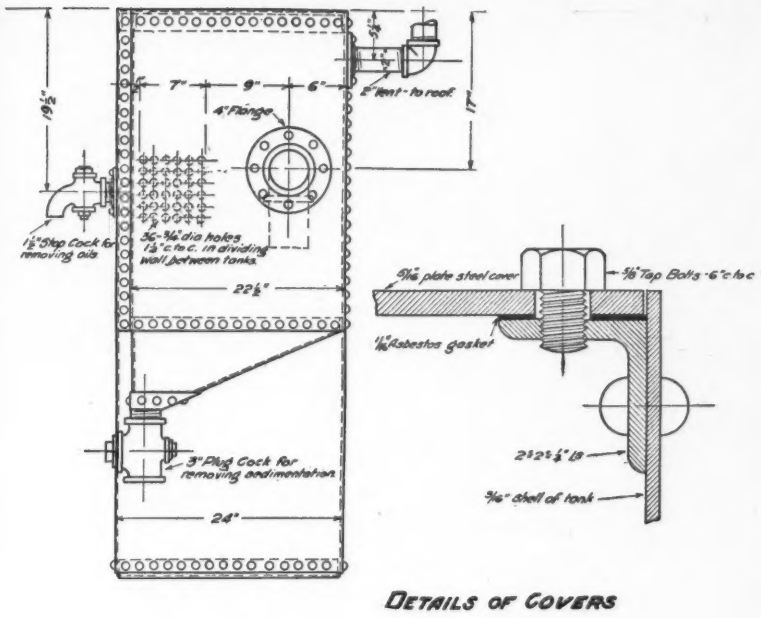


Plate b. Oil Separator.

ments prohibiting gasoline discharging into sewers. The New York Fire Department as an aid to the observance of the city ordinance above referred to has issued plans, specifications and regulations for an oil separator installation, the details of which are given herewith.

Regulations.

Filing of Drawings, Descriptions, etc., for the Installation of Oil Separators.

1. Drawings and triplicate descriptions, on forms furnished by the Bureau of Buildings and the Bureau of Fire Prevention for the installation of approved oil separators shall be properly filled in and filed by the owner or architect in the said Bureau. The plans must be drawn to scale in ink, on cloth or they shall be cloth prints of such scale drawings and shall consist of a floor plan on which the separator is to be located, showing all windows and door openings, passages, walls, partitions, enclosures, stairs and elevator enclosures, location of boilers or other heating, lighting and power devices having an exposed flame or spark, gasoline storage system, exposures; a general floor plan showing location of separator, the various floor drain lines connecting to it, the relief, the discharge and its connection to the house sewer (if any) and that much of the house drain

as will show the house trap and fresh air inlet; a vertical section or sections showing this latter plan in elevation; a plan and as many elevations of separator and its connections as are necessary to show clearly in detail those connections, together with their various sizes, and if the separator is located in pit full details and dimensions of the same should likewise be shown. Ample clearance for inspection and maintenance between separator and pit must be shown.

2. The said installation shall not be commenced or proceeded with until said drawings and descriptions shall have been so filed and approved by the Superintendent of Buildings and the Chief, Bureau of Fire Prevention.

3. No modification of the approved drawings and descriptions will be permitted unless either amended drawings and triplicate descriptions covering the proposed change or changes are so filed and approved by the Chief, Bureau of Fire Prevention and the Superintendent of Buildings.

4. The installation in all buildings both public and private shall be executed in accordance with the rules and regulations of the Bureau of Buildings (all Boroughs) and the Bureau of Fire Prevention.

5. Repairs or alterations of the separator and any other connection may be made without filing drawings and descriptions in the Bureau of Buildings and the Bureau of Fire Prevention, but such repairs or alterations shall not be construed to include cases where new vertical lines or horizontal branches of soil, waste, vent or leader pipes are proposed to be connected to the said separator.

6. Oil separators installed in any building where volatile inflammable fluids are used, must be arranged to be *readily accessible;* where located underground an iron, brick or concrete manhole must be provided with an iron or flagstone cover. They must not receive the discharge of house, outside court and area drains, toilets or leaders.

7. They must in all cases be connected by a Y-branch fitting to the house sewer on the public sewer side of house trap.

8. No separate trap need be provided on drain entering oil separators, but a running trap must be provided for each floor drain discharging to the separator.

9. When fixture or floor drains are located on any floor above the first, the lines to which they are connected must extend in full calibre at least one foot above the roof coping, and well away from all shafts, windows, chimneys or other ventilating openings. When less than 4 inches in diameter they must be enlarged to 4 inches at a point not less than one foot below the roof surface by an increaser not less than 9 inches long, and the traps of all fixtures vented.

10. Relief pipes must be provided at least 2 inches in diameter and carried independently above the roof and there capped with down-turned elbow equipped with fire screen.

11. Drainage from washstand in garages shall not be permitted to flow into sump pits.

12. All piping must be left exposed until after the Fire Department inspections.

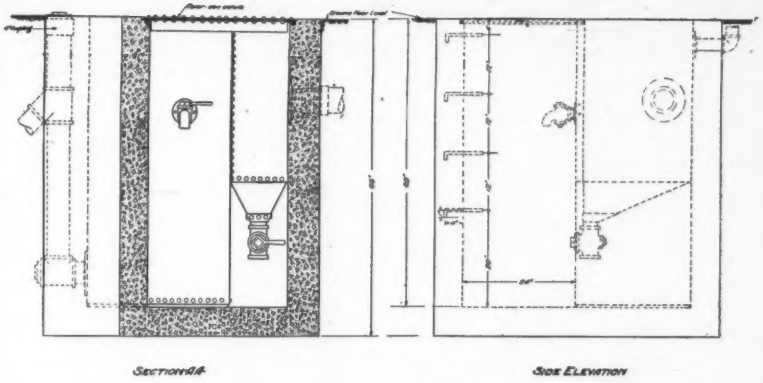


Plate c. Oil Separator. Access Well for Underground Installations.

13. Oil separator pit should be so located to prevent floor drainage flowing into it, or else have concrete curbing around it.

14. Where a pit is below the ground water table and there is a possibility of water being in the pit, the lining should be made impervious. (See drawing for underground installations.)

Specifications.

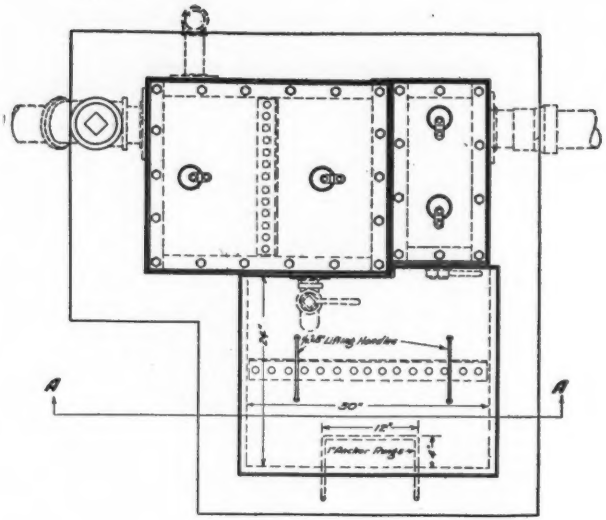
$\frac{3}{16}$-inch steel throughout, except covers.
Rivets ½-inch diameter, 2 inches center to center.
No soldering allowed.
Electric or acetylene welding permitted.
All joints to be caulked, where riveted.
To be gas and water tight.
All flanges to be riveted or electric or acetylene welded to shell.
Outside of separator to be coated with a rust proof coating.

Materials.

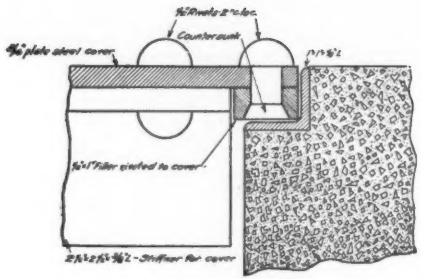
Two $\frac{3}{16}$-inch steel tanks riveted together, composed of one large tank, 24 inches by 30 inches by 60 inches, having riveted to its intake end, the small tank 22½ inches by 12 inches by 34 inches (end of large tank comprises division wall). Top of small tank on same level with that of large one.

Small Tank.—Either a steel or cast-iron hopper bottom riveted to small tank, about 9 inches deep by 22½ inches by 12 inches.

1 3-inch plug valve (brass plug—iron body).
1 box wrench to fit 3-inch plug valve.
1 connecting nipple (to connect 3-inch plug valve to hopper bottom).
1 4-inch threaded iron pipe flange riveted to tank.
1 4-inch by 6-inch nipple (threaded for its entire length).
1 4-inch by 6-inch iron pipe size nipple.
1 4-inch Tucker connection.
1 4-inch cast-iron elbow.



PLAN



DETAILS OF ACCESS WELL COVER

Plate d. Oil Separator. Access Well for Underground Installations.

One $\frac{5}{16}$-inch steel plate cover, two lifting rings connected.

2-inch x 2-inch x ¼-inch steel angles riveted all around inside near top for cover.

One $\frac{1}{16}$-inch asbestos gasket.

Large Tank.—One 2-inch threaded iron pipe flange riveted to large tank (for vent pipe).

One 2-inch x 7-inch nipple, iron pipe size.

One 2-inch elbow, 90 deg.

One 1½-inch threaded iron pipe size flange riveted to tank.

One 1½-inch stop cock for iron pipe (brass plug—iron body).

One 1½-inch x 1¾-inch nipple.

One box wrench to fit 1½-inch plug valve.

One 4-inch iron pipe size flange riveted to tank (outlet).

One 4-inch x 5-inch nipple iron pipe size.

One 4-inch cast iron standard T-fitting.

One 4-inch cast iron plug for T-fitting.

One piece 4-inch wrought iron pipe, 29 inches long, threaded both ends.

One 4-inch cast iron standard 45-deg. elbow.

One 4-inch cast iron standard plug for 45-deg. elbow (⅛-inch hole drilled in top for syphon breaker).

One $\frac{5}{16}$-inch steel plate cover with 2½-inch x 2½-inch x ⅜-inch stiffener attached.

2½-inch x 2½-inch x ¼-inch angle riveted to inside, all around near top for cover.

Two lifting rings riveted to cover.

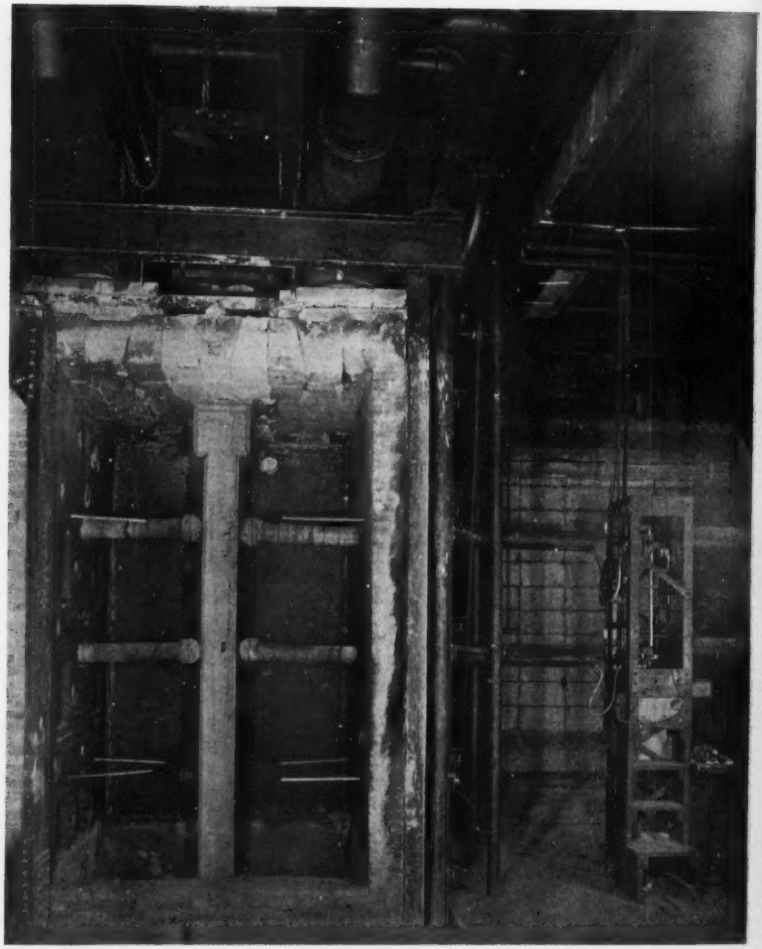
One $\frac{1}{16}$-inch asbestos gasket.

Fire Tests of Building Columns.

Fire Tests of Building Columns, being jointly conducted by the Associated Factory Mutual Fire Insurance Companies, the National Board of Fire Underwriters, and the Federal Bureau of Standards, at Underwriters' Laboratories, are progressing according to schedule, two columns being tested each week. The work of testing began last summer and will require a year for the completion of the full series of 100 tests. This was preceded by several years' work in designing and erecting the testing apparatus and in preparing and covering the test specimens by the different methods and with the various materials required for a full investigation.

The apparatus used in the tests consists briefly of a gas furnace capable of being controlled according to a specified standard temperature curve, reaching a maximum of 2300 degrees Fahr., (1260 degrees Cent.) at the end of an eight-hour test. The load on the columns while being subjected to fire test is supplied by means of a hydraulic ram, an average load of 100,000 pounds being maintained during the test, this being calculated for the various sections according to accepted formulas for working load.

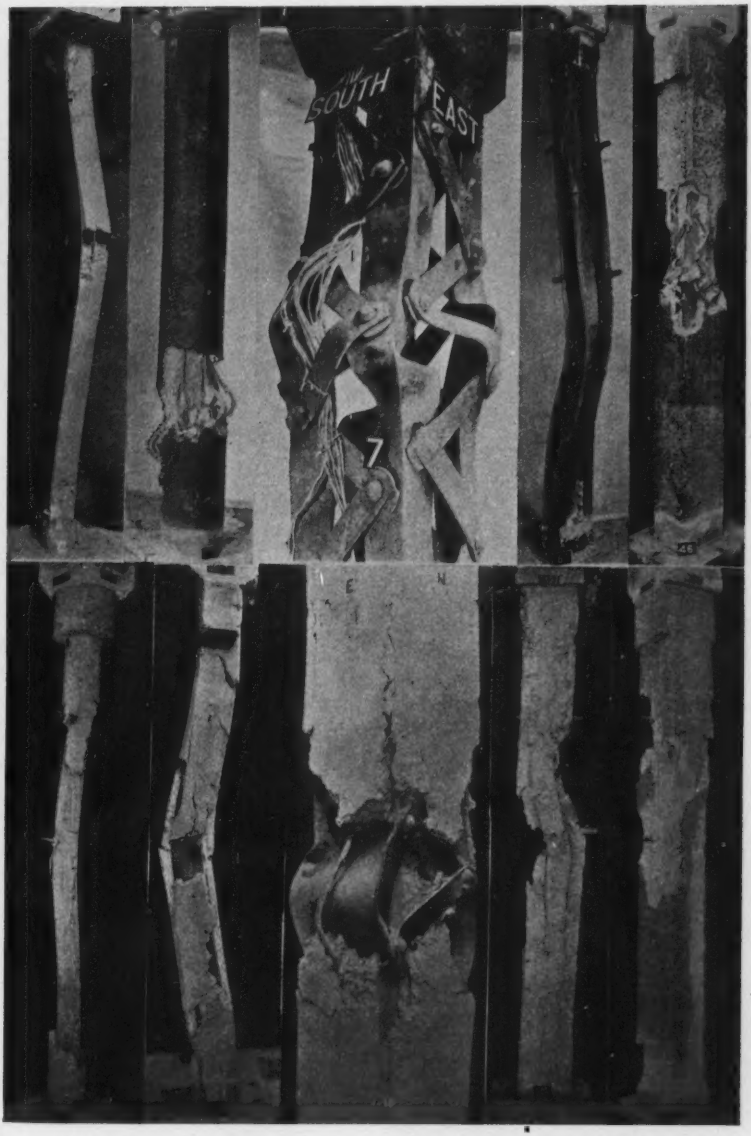
The temperature of the column furnace is measured by means of platinum and base metal thermo-couples, supported in porcelain tubes



Partial View of Building Column Test Furnace and Accessories, with column ready for test.

at two elevations; and that of the columns, by means of base metal thermo-couples attached to the metal of the column at four elevations and at different points in the section. The temperature indications are read with a potentiometer indicator and connections are also made to an automatic potentiometer recorder, so that graphic records can be obtained, if desired, of the indications of any set of couples.

The vertical compression and expansion of the columns, due to the load and heat, are measured over a gauge length of 37 inches in



Effect of load and fire on sample columns. All tests were continued to the breakdown of the samples.

the upper half of the column by means of wires attached to the column at each end of the gauge length, the other ends being weighted and passed over an idler at a point outside of the furnace and as far from the column as room conditions will permit. The wires are protected inside and outside of the furnace by suitable insulating and protecting tubes. Readings of vertical movement are taken at intermediate points on the wires by means of microscopes mounted in micrometer slides, the true movement at the column being calculated from the distance relations of the microscopes and the fixed end of the wire, with reference to the point of attachment to the column. The lateral deflection of the column is measured by means of readings on scales placed perpendicular to and parallel with the wires.

A partial view of the testing furnace and accessories with a column ready for test is shown herewith.

All of the tests are of full-sized columns of 12 feet 8 inches effective length and of various steel sections, which are protected by concrete, tile, and other forms of fire-protective coverings. One column of each type is tested unprotected; also several concrete columns reinforced according to methods used in current practice have been introduced.

The tests are continued to a break-down of the sample, and hence no inferences as to the comparative merits of the various column designs and column coverings should be drawn from the illustrations, which show simply the effect of load and fire on a number of samples which have been subjected to test. The time required to obtain failure varies with the type of material and thickness of covering, the periods for the columns so far tested ranging from 17 minutes for the unprotected column to over eight hours for the heavier types of protection.

This is the first work of this character ever undertaken employing modern forms of columns and methods of protection, and it is expected that it will develop data of great interest to city governments, underwriters, manufacturers, architects and engineers.

Specifications for columns and column coverings have necessarily been made ever since the advent of modern fire resistive construction, but there has been little or no experimental data as a basis for the various requirements promulgated, which in point of amount of protection required, differ by more than 100 per cent as between various city building codes.

It is also thought that the tests will give much information on the general fire-resistive qualities of the covering materials employed. Differences in point of effectiveness of over one hundred per cent have already been found as between concretes made from different aggregates, some showing up unexpectedly well and others indicating decided unsuitability for use where the fire-resistive feature is a point of importance.

Department of Fire Record.

Motion Pictures—Fire Record.

All fire records are inevitably to a considerable extent records of human carelessness, but it is seldom that the element of carelessness is so glaringly exhibited as in the present study of motion picture fires. Admittedly films of the inflammable type present serious hazards, but these hazards are for the most part palpable and easily intelligible. These films ignite readily when subjected to heat or flame and are liable to burn with explosive violence when ignited, and, since neither the human machine nor the humanly produced projection machine is invariably mechanically perfect, there will remain the probability of occasional accidental fires attributable to these characteristics so long as inflammable films are used. By far the greater number of the fires included in the record, however, are outside the category of excusable accidents. The fact that over one-half the fires due to common causes were the result of careless smoking speaks for itself, while a perusal of the particulars of the special hazard causes will reveal the presence among a section of the operators of a spirit of recklessness which is little short of criminal.

A study of the record also shows how much depends upon the operator in motion picture theatres. The question is not merely one of skill, but of the higher qualities of character. Smoking in the booth at all—to say nothing of extremes of foolhardiness like that which turns the crank of the machine with one hand, rewinds a film with the other, and cheerfully puffs at a cigarette meanwhile—is an offence the gravity of which is increased in proportion to the skill and intelligence of the operator. It ought also to be remembered that operators sometimes atone nobly for acts of carelessness, although it is equally true that the careless often prove to be the cowardly and selfish. There is a vast difference from the point of view of safety, as well as of character, between one operator who took a chance in dropping a hot carbon, but gave his life in confining the flames within the booth, and another who in a similar case kicked the burning film out of the booth and destroyed, not only the theatre, but some adjoining buildings. It is to be observed also that in several cases reported the coolness and self-control of operators after the discovery of fires due to no fault of theirs were potent factors in preventing loss of life and property.

At the Association's Annual Meeting in May last, Mr. C. Francis Jenkins, representing our member, the Society of Motion Picture Engineers, suggested that the concealing booth was an unnecessary

fire hazard, and the fire record certainly proves that there are many operators who cannot be trusted out of sight. Even those who favor the use of booths will admit that a booth which serves no other purpose than that of concealment is an unmixed evil, and that if a booth is to be used it should be of standard construction. Notes will be found in the record of several cases where well-constructed booths properly vented to the outer air were of great service in preventing panic when fire occurred.

It will be observed that for the purpose of obtaining a motion picture fire record, both picture theatres and film exchanges have been included. The film exchange fires in particular give cause for grave criticism of those employers who endanger the lives of their workers by failing to acquaint them with the hazards of the material they are handling and by locating their business in fire traps in which holocausts are practically certain, should serious fires occur. The momentary carelessness of an operator who will himself be involved in the consequences of his act is certainly deserving of less censure than is the deliberate and constant exposure of other men and women to dangers which are well recognized and can be to a great extent obviated by comparatively small expenditures of money. Those who exhibit cheap motion pictures in hazardous old structures which have been abandoned by the producers of shows of a better class are, of course, equally culpable.

In tabulating the results of the study, the special hazard causes have been analyzed in more detail than usual, as it was felt that where the individual element entered so largely this method was the only one which would satisfactorily bring out the hazards.

The number of sprinkler fires was too small to permit of the preparation of detailed sprinkler tables which would have statistical value, but it may be observed that where sprinklers were installed they were of great service.

MOTION PICTURES—FIRE RECORD.

Total Number of Fires Reported, 157.

1. Classification of Causes.

Common Causes.

	No. of Fires	Per Cent. of Common Causes	Per Cent. of Known Causes
Heating	2	4.8	1.7
Lighting	12	28.5	10.3
Boiler (or fuel)	1	2.4	.9
Smoking	22	52.4	18.9
Lightning	1	2.4	.9
Rubbish (or sweepings)	1	2.4	.9
Miscellaneous	3	7.1	2.6
	42	100.0	

Special Hazard Causes.

	No. of Fires
Films ignited during operation of projection machine (no details)	13
Electrical troubles connected with operation	9
Over-exposure of films to arc light of machine (no details)	7

Carbons in contact with films	5
Films jammed in machines; automatic shutters out of operation	3
Films broke in machine	3
Fire started in booth (no details)	2
Ignition of gasoline or gasoline vapors during cleaning of films	2
Films ignited (cause unknown)	2
Films ignited by sparks during testing	2
Films ignited by sparks from carbons	2
Failure of automatic shutter on machine	2
Films in contact with hot rheostats	2
Film ignited by spark from motor operating cleaning machine	1
Threading film on machine with arc light in operation	1
Explosion of lamp in examining lantern	1
Film in contact with unenclosed motor under examining table	1
Film in contact with lamp house when "take-up" device failed	1
Leak in tank of gasoline picture machine caused explosion	1
Absence of automatic shutter	1
Spontaneous combustion in can of film clippings	1
Machine operated by unauthorized employee	1
Film backed up into light in motor-driven machine while operator was engaged in re-winding	1
"Green" operator	1
Upsetting of pot of melting paraffine	1
Film ignited during re-winding (cause unknown)	1
	67

	No. of Fires	Per Cent. of Known Causes
Common Causes	42	36.2
Special Hazards	67	57.8
Incendiary	5	4.3
Exposure	2	1.7
Total Known Causes	116	100.0
Unknown Causes	41	
	157	

Details of Causes.

Under this heading are given brief descriptions of fires caused by unusual conditions or of an educational value in emphasizing the different hazards. Fires caused by ordinary conditions or well understood hazards may not be included.

Common Causes.

Heating.

H-7341. The night was extremely cold and the heating plant was forced in order to keep the rooms of the exchange comfortable. The heat in the steam pipes was sufficient to start combustion of film material in contact with them. **Investigation subsequent to the fire made it apparent that the employees had little or no knowledge of either the composition or danger of the material they were handling, other than that it was inflammable if ignited by the application of fire.**

Lighting.

H-10087. An electric drop light, hanging from the ceiling over an employee's table used for patching films, was struck by his shoulder and swung against some metal boxes, breaking the globe and setting fire to some films on the table. About a dozen employees on the floor at the time of the fire had some difficulty in getting out through the thick, choking smoke. One entire story was practically gutted. **Lights in rooms where films are stored or handled should be protected by wire guards or vapor-proof globes.**

H-12311. The tables on which film was joined or examined had electric lights in them, located in wells or covered by heavy pieces of glass. The glass cover in one of the tables was very loose fitting, not being the piece originally made for the opening. This cover is thought to have fallen on the electric light globe, with the result that the film on the table caught fire. The flames ignited other films in the vicinity and filled the premises with a dense irritating smoke which made it difficult for some of the employees to get out. Several employees were burned about the hands and arms while trying to put the fire out by throwing film on the floor and stamping on it.

Smoking.

H-2519. A boy was repairing a film and evidently smoking at the same time. When the film ignited he threw it on the floor in contact with a number of boxes containing other reels. These ignited and produced a fierce blaze, which was finally extinguished by the fire department. All the films were destroyed and two machines somewhat damaged. The loss was several thousand dollars.

H-5726. Operator was turning crank of picture machine with one hand and rewinding a film with the other. The indications are that he was also smoking, and that he accidentally touched the film, which was being rewound, with the lighted end of a cigarette.

H-8505. When the house was darkened for the pictures a cigarette fiend lighted up and, after satisfaction, threw the butt on the floor, where it rolled through a crack separating the balcony rail from the balcony floor, igniting sweepings that had sifted through the same orifice. Smoke was noticed coming through the balcony floor and was clearly shown on the picture screen. The operator called the stage manager on a private telephone between the booth and the stage. The manager and two assistants cut through the floor with fire axes and extinguished the blaze with chemical extinguishers.

Miscellaneous.

H-10016. This fire occurred in a one-story brick film storage house, 18 feet by 63 feet, divided into five non-communicating compartments and containing several thousand reels. The probable cause was the heat of the sun's rays directed into the interior of the building by the prism glass skylight in the roof and focussed

upon an open reel of film, of which there were several in the compartment in which the fire started. One of the employees stated that an unusually irritating atmospheric condition prevailed in this compartment for some time previous to the fire. This indicates that the disintegration of the material may have started as early as the afternoon of the day previous, with gradual increase of temperature until the point of ignition was reached. The pressure from the gases given off by the films caused the falling of the walls, with a consequent collapse of the roof. Three of the compartments were destroyed with contents, wall and roof. The films in the fourth were destroyed, the fifth being used for miscellaneous storage (no films). The window frames of the adjacent buildings showed the effect of the heat, although the fire was to considerable extent blanketed when the roof fell.

Special Hazard Causes.

Carbons.

H-4555. Operator *dropped* instead of *laying* a hot piece of carbon into a receptacle for burnt carbons. A resultant spark ignited films in a sheet-iron box, the lid of which had not been closed.

H-6801. Finding it necessary to renew a burned-out carbon, the operator threw the used piece on the floor, where it came in contact with a reel. Fortunately, a panic was averted, although two narrow doors were the only means of exit, and the audience was apprized of its danger. The loss was $600.

H-11851. Operator wanted a 6-inch piece of carbon to use upon his machine, and took out a 12-inch piece for the purpose of breaking it in two. In doing this, he dropped a part of the hot carbon into the re-wind. When fire resulted he stuck to his post, and lost his life through his endeavors to smother the flames. Fire was confined to the booth.

H-11908. In his excitement after dropping a hot carbon on a reel, the operator, while attempting to extinguish the flames, kicked the film outside the booth. The building was of wooden construction and fire spread with great rapidity, destroying not only the theatre, but two adjoining buildings as well.

Film Examining.

H-10846. This fire was discovered by an employee who had left the room for a short time, and returned to find the examining table ablaze. The examining and re-winding machine was located on a wood metal-covered table, and obtained power by belt from a motor located on a shelf under the table. Power was thrown on and off by means of a treadle operating a friction clutch. This machine had been in operation just before the employee was called away, and it is supposed that an end of the film came in contact with the motor, which was not enclosed.

S-18034. Films were examined for imperfections by passing them in front of a lantern consisting of a sheet of enameled iron about 4 feet wide by 3 feet high, mounted on a standard to bring it to a convenient working height. The upper and lower edges were curved over, and in each of these curves four 110-volt lamps were placed. Film was unrolled by two operators from the two reels at the top, and after examination it passed into wicker cloth-lined baskets, from which it was re-reeled. One of the lamps seems to have exploded and ignited the film. **Protection of the lantern with a sheet of glass would have prevented this loss.** The fire was a quick flash, but sprinklers opened very promptly and extinguished it.

Shutter on Projecting Machine.

H-7221. Operator fastened up the shutter, and during an obstruction to its passage through the machine the film was allowed to remain exposed to the light. Fire communicated to a piece of film that had flapped over, and when the operator seized the burning material and threw it down, it came in contact with an exposed reel on a shelf. The latter took fire and the operator left the booth, to which the fire was confined by a self-closing door. A panic occurred among the audience, but happily no one was injured.

H-10232. Operator attempted to open the lower magazine door and turn the crank at the same time. The door stopped the crank long enough for the film to ignite, there being no automatic shutter on the machine. No damage was done to the building, but 700 feet of film were burned before the magazine door was closed. Enough fire got into the booth to cause the shutters to drop.

H-11724. The automatic shutter, which was not in working order, failed to close and cut off the light from the film when the machine was stopped by the operator for the purpose of adjusting the focus. Film ignited, and when an attempt was made to throw it from the booth, it fell into a box or carrying case containing seven reels. All these were destroyed, and the booth, which was not lined, was seriously damaged. The prompt arrival of the fire department prevented a heavier loss.

Motor-Driven Machines.

H-6229. An old-style combustible film was being shown, the machine being operated by an electric motor, and the operator's attention was engaged in re-winding a non-combustible film in preparation for exhibition. The film on the machine broke, and before the operator could stop the motor a considerable portion of it had taken fire and the flames had communicated to the magazine. In his efforts to remove film from the magazine, the operator suffered painful burns.

Incidentally it is of interest to note that the presence of a partially used package of tobacco, together with a pipe, suggested the possibility that smoking sometimes occurred in the booth.

H-6715. Film backed up into the light while it was being shown on a motor-driven machine. The operator's back was turned, as he was engaged in re-winding another film. He noticed a flash, which was followed by an explosion due to the passage of fire through the snuffing rollers into the magazine. A film on another machine and two films lying on the floor were also ignited. Two chemical extinguishers with which the operator tried to extinguish the flames were found to be defective, and water buckets were used. Two machines were badly damaged and much plaster broken off the walls.

Electrical Troubles.

H-7520. It is claimed that the picture machine became grounded and while operator was putting film into metal magazine provided for storage of reels not in use, the cover of the container struck the standard of the machine, causing an arc which set the film on fire. Two hand extinguishers were used by the operator, but are stated to have had no effect upon the fire.

H-9141. A defective "remote" automatic switch in the booth became overheated, and, being located in a wooden cabinet lined with tin, caused continuous penetration of heat through to the wood and thence to wire lathing. The latter set fire to a large exposed roof timber immediately above the booth. Fire extended up to a space between the ceiling and the roof, where it evidently burned for a long while before discovery. The roof and girders were destroyed and the metal ceiling was pulled down by the firemen. The loss was about $8,000.

H-11662. Film was being run through a test machine driven by an open brush motor controlled by a knife switch. It is believed that ignition was caused by a flash from the switch when it was pulled open. The fire occurred just by an open door, and was communicated immediately to a large stock of film in an adjoining vault, from which it spread until it had destroyed the whole five-story building.

Film Cleaning.

H-12304. Fire originated during a process of cleaning films of oil spots. Films were passed between two thick layers of linen saturated with gasoline and held down with weights in a shallow pan about nine inches long. The attendant was in the act of adding to the weights when a flash occurred and burned through the film. The man attempted, without success, to tear off one of the burning ends of the film before the fire should communicate to the receiving reel, and at the same time the blaze extended from the other side of the pan to the discharging reel, the entire film on both reels being burned. The flame was lessened by buckets of sand thrown by the attendant, and did not extend beyond the film. The ignition of the gasoline was probably due to static electricity, the metal pan serving as a condenser. It was observed that electric action was intensified

by the frictional rubbing on the film between fabrics which had been rendered harsh and favorable for the production of sparking by their saturation in gasoline.

MISCELLANEOUS STATISTICS.

2. Analysis of Loss.

	Common Causes		Special Causes		Unknown Incendiary Exposure		Total	
	No. of Fires	Per Cent.	No. of Fires	Per Cent.	No. of Fires	Per Cent.	No. of Fires	Per Cent.
No Claim	..	..	7	12	..	..	7	5
Small Loss	25	74	39	69	24	55	88	65
Large Loss	9	16	11	19	20	45	40	30
Total with data given...	34	100	57	100	44	100	135	100
No data	8		10		4		22	
Total	42		67		48		157	

3. Day or Night Fires. (Day Fires 6 a. m. to 6 p. m.)

	Common Causes		Special Causes		Unknown Incendiary Exposure		Total	
	No. of Fires	Per Cent.	No. of Fires	Per Cent.	No. of Fires	Per Cent.	No. of Fires	Per Cent.
Day	16	41	29	48	15	37	60	43
Night	23	59	32	52	26	63	81	57
Total with data given...	39	100	61	100	41	100	141	100
No data	3		6		7		16	
Total	42		67		48		157	

4. Establishment in Operation.

	Common Causes		Special Causes		Unknown Incendiary Exposure		Total	
	No. of Fires	Per Cent.	No. of Fires	Per Cent.	No. of Fires	Per Cent.	No. of Fires	Per Cent.
In operation	24	63	51	91	9	26	84	66
Not in operation	14	37	5	9	25	74	44	34
Total with data given...	38	100	56	100	34	100	128	100
No data	4		11		14		29	
Total	42		67		48		157	

5. How Discovered.

	Common Causes		Special Causes		Unknown Incendiary Exposure		Total	
	No. of Fires	Per Cent.	No. of Fires	Per Cent.	No. of Fires	Per Cent.	No. of Fires	Per Cent.
Employee	21	57	54	87	15	43	90	67
Watchman	..	..	..	..	2	6	2	2
Sprinkler Alarm	3	8	1	2	3	8	7	5
Outsider	13	35	7	11	15	43	35	26
Total with data given...	37	100	62	100	35	100	134	100
No data	5		5		13		23	
Total	42		67		48		157	

SPRINKLER FIRE RECORD.*

6. Effect of Sprinklers.

	No. of Fires	Per Cent.
Extinguished or Practically Extinguished Fire	19	73.1
Held Fire in Check	7	26.9
Total	26†	100.0
No Claim	2	8.4
Small Loss	17	70.8
Large Loss	5	20.8
	24	100.0
No data	2	
	26†	

*There were 7 fires in which no sprinklers were opened.
†2 of these fires are omitted from Table 7 owing to insufficiency of data.

7. Number of Sprinklers Opened.

No. of Sprinklers Operating	Extinguished Fire		Held Fire in Check		Total	
	No. of Fires	Per Cent.	No. of Fires	Per Cent.	No. of Fires	Per Cent.
1	7	36.8	2	40.0	9	37.5
2	3	15.8	1	20.0	4	16.7
3	2	10.5	1	20.0	3	12.5
4	2	10.5	..	..	2	8.3
6 to 9 incl.	3	15.8	..	..	3	12.5
10 to 24 incl.	1	5.3	1	20.0	2	8.3
25 to 49 incl.	1	5.3	..	..	1	4.2
	19	100.0	5	100.0	24	100.0

No. of Sprinklers Operating	No. of Fires	Per Cent. of Whole
1	9	37.5
2 or less	13	54.2
3 or less	16	66.7
4 or less	18	75.0
Less than 10	21	87.5
Less than 25	23	95.8
25 and over	1	4.2

Points of Interest from Fire Reports.

Automatic Sprinklers.

S-6813. Fire originated in operator's box, either by spark or short circuit igniting the celluloid films, causing a quick and hot fire. Two sprinklers operated and virtually extinguished the flames. The prompt action of the sprinklers certainly prevented a serious loss and probably saved the entire building, which was old and much worn, and in which the fire would have spread rapidly.

S-18509B. In this case a film became ignited at an examining table. Nearby were 150 rolls of film, 20 of which were in open cans, the remainder being in tight cans. The fire was intense at the start, but nine sprinklers operated and practically extinguished it before it had a chance to destroy other than the film on the examining table and those in the open cans. So successful were the sprinklers in controlling the fire that not even was the varnish on the tight cans blistered. Other material in the room, with the exception of a pile of paper advertising matter, one desk and some empty cement bags belonging to a contractor who happened to be putting up a partition about the room, was not even scorched. The smoke was so dense that three firemen were overcome when they attempted to enter the room.

First Aid Appliances.

H-2343. Operator was smoking, and left operating room as soon as he had started the fire. The room was tin lined, and the fire burned itself out before the arrival of the fire department. A chemical extinguisher in the show-room would not work when an attempt was made to bring it into service.

H-3525. This was a total loss. There was no water available to extinguish the fire in its incipiency. It was stated that half a dozen buckets would have saved the property.

Construction and Ventilation of Booths.

H-6221. A helper was re-winding a used film inside the booth, and ignited the same with a cigarette. The operator threw the burning reel on the floor, and the heat caused two other reels to fume, driving both operator and helper from the booth. The ventilating pipe carried the fire and smoke to the outside, and no smoke entered the hall. Most of the audience remained in the hall and watched the effect of the fire.

H-6682. This fire was caused by the breaking of a piece of film during exposure. The flash was not observed by the audience, and did not extend to the magazine. A slight smoke was carried outside through the ventilating pipe and, being observed in the street, caused an alarm. The audience, however, remained until a new reel was introduced and the exhibition continued. No panic occurred.

H-7228. The motion picture machine was motor-driven, and when fire occurred as the result of a failure of the "take up" device, the operator was outside the booth re-winding a film. He ran into the booth, and was severely burned in an attempt to extinguish the flames with a coat. Two extra films outside the booth were destroyed, owing to the fact that the openings in the booth were not arranged to close automatically, and an opening on the rear side, equipped with a gravity door, was not closed during the fire. The operator was also unable to get the main door closed. The three reels burned were described as non-inflammable.

S-14577. The film being shown evidently became overheated from the arc light of the machine and burst into flame. Fire spread to the insulation of the wires connected to the machine and an electric fan in the booth. There was nothing else to burn, as the booth was constructed of heavy sheet iron on angle iron, and was well ventilated to a metal flue. To this latter fact it is no doubt due that the sprinklers around the booth did not operate. The fire was extinguished by an employee with a chemical extinguisher before the fire department arrived, and the audience did not know that there was any fire. The machine was not seriously injured, and the show continued.

Non-Inflammable Film.

S-9469. Fire occurred at a stock table from which films are passed out to examiners. When the fire started there were probably between 200 and 300 rolls tightly coiled and held by rubber bands, but not boxed. After examination, it was customary to put the rolls in metal closets, unboxed, behind the stock table. The sliding metal doors are said to have been open at the time of the fire. About 90% of the films were of the non-inflammable kind, and these, though badly scorched, apparently did not burn to any extent. Films lying on examining tables which did not burn were merely wrinkled by the heat and water. Inflammable films were reduced to ashes.

Storage and Handling of Film.

H-7987. The only means of entrance to this film exchange room, which was located at the top of a three-story building, was through another room, across a board walk laid on a slag roof, or by the elevator. Two employees were in the room when fire occurred, evidently as a result of smoking. The blaze spread so rapidly that the entire room was in flames before either of the men could get out. The roof was completely burned off, and the fire department did excellent work in confining the fire to the room. This was not in any sense of the word a standard exchange. **Numerous films lay around on tables, and two safes, each containing about 250 films, were left with the doors blocked open.**

Exits.

H-5362. The spread of this fire, which occurred in a film exchange on the second floor of a twelve and one-story, basement and

sub-basement fire-resistive office building, was very rapid, and although it was of short duration, and was quickly extinguished after the films had been consumed, the excessive smoke and heat at the main stairway and elevators caused considerable obstruction to the escape of occupants from the upper floors. **In fact, although there were two stairways in the building, neither of them was accessible for a time to the occupants of the upper portion of the main wing,** as it was necessary to pass close to the main stairway and traverse the entire length of the hallway in the other wing to reach the stairs in that section. This hallway and stair shaft were also filled with smoke.

Construction.

H-11255. Although the films at this exchange were not stored and handled in an approved manner, poor construction was the principal factor in the spread of a fire which caused the deaths of three employees and injuries to quite a number. The entire second floor is stated to have been aflame and filled with dense smoke and gases within three minutes after the first flash occurred on the first floor. There were no proper fire-stops between the floor and ceiling joists where they rested on the wall plate of the stairway partition, which was wood studding, with metal lath and plaster in the first story only. Above the ceiling line of the first floor the partition was of light wooden construction, and burned very rapidly. The material used for ceiling was 3-ply paper board, which was tacked directly to the bottom of the second floor joists and painted to represent metal. The spaces between the second floor joists communicated directly into the stair shaft, and as soon as the paper ceiling was burned the flames and smoke, increased by the natural draft in the stairway enclosure, spread rapidly to the second floor, making short work of the light wood and glass, oiled and varnished partitions.

A secondary feature in the holocaust was the obstruction of the rear windows by work benches and boards nailed over the lower part of the windows.

H-12651. This building was of brick joisted construction, being the oldest theatre in the town. It had formerly been used for staging good shows, but at the time of the fire was occcupied as a cheap motion picture theatre. The fire, once started, made rapid headway, and very quickly burned out the entire structure, nothing being left inside except part of a balcony and lobby.

H-12681. Evidently sweepings and refuse were occasionally swept down some wooden stairs leading to the basement of this fire-resistive building. The stairs were destroyed, and only the good construction prevented the spread of fire and a serious loss.

Chimney.

H-3576. While pictures were being shown, an employee discovered a light stream of smoke coming up through the floor round a chimney flue, near the main entrance to the theatre. He imme-

diately reported his discovery to the proprietor, who ordered the operator to throw "Good Night" upon the screen, thus quietly dismissing the audience. A prompt alarm brought the firemen, who went to the cellar, which was full of smoke. The cellar being nearly 300 feet long, a considerable search was necessary to locate the fire. It was found burning against an old chimney into which a smoke pipe had been run from a furnace installed when the property began to be used as a theatre. The capacity of the old chimney being insufficient, heat penetrated the bricks to the floor support, causing charring and, finally, ignition. The fire was confined to a small space, very little damage being done beyond the tearing up of the floor. Unhappily, one of the officers of the fire department who had lost his way amid the smoke in the cellar was overcome, and died in hospital a few days later.

Concealed Spaces.

H-8599. This fire is attributed to a cigar stub in the ticket office. The building was of wood, iron clad and iron lined, and the fire, before it was discovered, had worked its way in under the iron. The only way to reach the seat of fire was to remove iron from the building, and this could not be done quickly enough. The result was a total loss.

S-20726. When the fire department arrived at the theatre, fire was burning fiercely in blind spaces between the ceiling and roof and between the ceiling and floor of balcony. A wooden roof truss subsequently collapsed, causing the central portion of the roof to fall in, with the result that one fireman was killed and nine others seriously injured. Apparently the fire originated in the space between the ceiling and the floor of the room at the front railing in the central part. Thence it spread through concealed spaces to the rear and sides of the theatre, eventually reaching the main roof space through a hollow wall partition which separated the stairway to the gallery from the balcony section and communicated at the bottom with the floor space under the balcony, and at the top with the main roof space. Quantities of sweepings, including matches burned and unburned, which had dropped through cracks in the balcony floor, were found in the space where the fire started.

General Fire Record.

Stock Yards Fire, Kansas City, Kansas.

October 16, 1917

Special Report by Kansas Inspection and Fire Prevention Office, Charles E. Eldridge, Manager. (Member N. F. P. A.)

Description of Property.—The Stock Yards are composed of three sections, the fire being in the Main or South Yards. The North Yards and West or Quarantine Yards were not damaged. The Main Yards consisted of 45 acres of open cattle pens, over two-thirds being in Missouri, with elevated covered frame viaducts or runways every 400 feet. These pens were built of heavy timbers, with wood hay troughs, concrete water troughs, and with piles of 15 to 20 bales of hay stacked on top of fence corners in nearly every pen. The largest receipts in the history of the yards and the world's record had been handled the previous week, and the cattle pens were full the night of the fire. To the west, the double-deck Hog House of 275,000 square feet area (six acres) was a frame structure with open sides and with many overhead frame runways connecting to the cattle pens. This old hog house was in poor repair and would probably have been torn down next year. The ten-story Live Stock Exchange Building stands near the center of the Cattle Pens on Genesee Street, on the Missouri side, within 500 feet of the fire. Southeast of the Exchange are the brick Horse and Mule Barns, Fine Stock Pavilion, and, beyond, the Sheep Barns, all in Missouri, and out of the path of this fire. South of the frame Hog House stand four completed sections of the new concrete Hog House. These are three-deck reinforced concrete structures with open sides and wood fences for pens and runways. The north section was filled with wood forms and fence lumber, there being only a few pens erected on the top story. Adjoining the concrete Hog Houses on the south is the fire-resistive Power House and Pump House. To the west is a high concrete unloading dock built on the Kaw River dyke.

Occupancy.—The north part of the Main Yards, to which we refer hereafter, was occupied for butcher, stocker and feeder cattle and for hogs. The speculators' pens were at the northeastern corner of these yards. There were approximately 10,000 cattle and 3,100 hogs in the yards on the night of the fire.

Heat and Light.—The scale houses were heated by coal stoves safely arranged. All scale houses in cattle yards were fire-resistive. Electricity for lights was from own power house, in fair condition. The yards were well lighted at night.

A general view of the Kansas City Stock Yards holocaust.

Smoking.—Signs had been posted several times, but rule was not enforced, and "everybody smoked."

Railroad Exposure.—There were private switch tracks within the yards, and the Union Pacific main lines were adjoining on north.

Watch Service.—There were three night watchmen patrolling, 12 M. D. T. call boxes, and 12 Newman clock stations, all in the main yards. The M. D. T. record shows watchman was pulling M. D. T. boxes in northeastern part of yards at time fire started, and must have passed within 200 feet of the fire. There were two other special watchmen not on regular rounds. The Missouri Home Guards had recently been on patrol duty nearby, but had just been called off the Kansas properties the day before. Two battalions of these guards assembled at the fire, but were not asked to assist.

Time of Fire.—Tuesday morning, October 16th, 2.25 a. m. to 8.30 a. m.

Alarm.—Fire was discovered in the northeastern part of yards by Union Pacific watchman at Kaw River bridge, north of the yards, and by the Stock Yards watchman, who turned in alarm to M. D. T. office at 2.26 a. m. The Kansas Fire Department was called by telephone from a coal office two blocks north of the Stock Yards and half a mile from scene of fire. This alarm came in at 2.34 a. m.

Another photograph taken in the Kansas City Stock Yards after the fire.

Cause.—Evidence is being gathered by Government agents attempting to show the fire was incendiary. The following facts would seem to support this theory:

1. The first fire company, it is reported, saw fire burning in three places.

2. The fire started at a point fully 500 feet from the nearest railroad switch.

3. The fire started near east side, hence the east wind, which was blowing strongly, spread the fire toward the main values.

4. The yard was crowded with stock, the fire occurring at a time when the most destruction of property could occur, and at a point where it was sure to spread rapidly.

5. A serious labor strike occurred in the Stock Yards and Packing Houses one month ago, and one of the leaders, a Stock Yards scaleman of German descent, was discharged.

6. The statement of the watchman discovering the fire was that "it was set." The watchman himself or some employee may have been smoking and dropped a spark in hay, this being the cause assigned for the fire three years ago at these yards.

How Fought.—All the down-town departments of Kansas City, Missouri, and six companies from Kansas City, Kansas, were at the

fire. The apparatus included one steamer from Kansas and four from Missouri. The Stock Yards employees endeavored to use the private hose lines on the elevated viaducts, but were driven back by the swiftly advancing flames, and many standpipes were left open. These and other standpipes that were broken allowed much water to escape, seriously affecting the water pressure. The Stock Yards are well supplied with private hydrants and standpipes all fed by 10, 8 and 6-inch mains from three private steam pumps. Water supply is secured from the Kansas City, Missouri, flow line. There are also three high-pressure connections from Kansas and one 8-inch high-pressure connection from Missouri mains. The gauge in the Stock Yard Power House shows 45 pounds pressure at 3.15 a. m. The night engineer was a new man, and had difficulty getting the pressure up to this point. About 4 a. m. the pressure rose to 55 pounds, but at 4.30 an 8-inch main across the Stock Yards bridge broke when the bridge burned, and the pressure was valueless until this 8-inch main was shut off an hour or more later. The steamers provided a few efficient streams, but the strong east wind and the delay in getting these streams into action allowed the flames to get beyond control. The fire stopped spreading about 5 a. m., and was practically extinguished at 7 a. m., after destroying fifteen acres of cattle pens, six acres of double-deck hog houses, one section of new concrete hog houses and all woodwork of the Kaw River bridge.

The fire was stopped on the west by the Kaw River and on the south by the concrete hog houses and by hose lines brought in through the main alley past the Stock Exchange Building.

Pressure.—Weak at Stock Yards hydrants, old pumps not being adequate, and too many open standpipe and hose lines that overtaxed the pumps. Four new pumps were on the ground, but not installed. The Missouri waterworks furnished 80 pounds pressure to hydrants in Genesee Street, but this was cut down by the 8-inch connection feeding into the Stock Yards mains.

Amount of Loss.—

Approximately 10,000 cattle,	worth about....	$1,000,000
Approximately 3,000 hogs,	worth about....	75,000
Frame pens and runways,	worth about....	120,000
Frame hog sheds,	worth about....	50,000
New concrete hog house,	worth about....	20,000
Total fire loss.....		$1,265,000

Lessons from the Fire.

1. The need of unusual water supplies in fighting fires in large frame areas.

2. The need of extra night watchmen in war times and times of labor disputes.

3. Reinforced concrete will not withstand excessive temperatures caused by burning of large quantities of combustible contents, especially when water is thrown on. Nearly every floor slab in the

damaged hog house section was broken through, leaving a hole from one to six feet in diameter. All columns and girders were badly damaged, but none were out of line, and no floor slabs gave way entirely.

4. In extensive Stock Yards fire-resistive zones should be established in which no wood construction should be allowed. These zones should separate the property into natural divisions and be of sufficient width to allow the full use of local fire apparatus.

5. Smoking in Stock Yards should be prohibited and rule enforced.

6. Telegraph fire alarm boxes needed in all mercantile and manufacturing districts.

Previous Fires.—This Company has suffered two other disastrous fires in recent years. On October 6, 1914, at 9.28 p. m., a large section of the stock pens was burned, causing $50,000 damage to Kansas side and $97,000 on the Missouri side. Several years previous to above, fire destroyed the large sheep barns on the Missouri side.

Fire at Plant of British-American Chemical Co., College Point, N. Y.

October 13, 1917.

Special Report by New York Fire Insurance Exchange, Willis O. Robb, Manager, (Member N. F. P. A.)

Description of Building: The area of the plant was 208 x 485 = 101,000 square feet. The height was one story, twenty feet, the walls were hollow tile, the floors concrete on earth, the roofs were boards on joist, composition covered. The goods manufactured in the building were salicylic acid and aeroplanes.

Alarms: The trouble evidently started somewhat before 4.00 a. m. Some one in the neighborhood ran to the Fire Department engine house about 1000 feet distant and while the company was turning out, at 4.15 a. m. a street box sounded. Upon arrival the firemen found the fire to be of considerable size and according to their reports it was breaking through the roof. The Chemical Company's watchman appears to have been the first to discover the fire. He spread the alarm in the plant and remained therein to fight the fire.

A second alarm was pulled at 4.43 a. m. and the third at 5.00 a. m. calling out a total of two hose, four engine and two truck companies.

Cause: Investigation seems to point definitely to the inception as having been in "Still" No. 7 used for sublimation of salicylic acid. The cause is thought to have been an over-supply of air or a supply of excessively heated air or both to the stills, brought about by the negligence of the employees who are said to have left the stills to their own devices and congregated in the office. Abnormal air condition acting upon the salicylic acid in the process of sublimation

produced and ignited inflammable product (more or less in suspension) in the stills, vents and the receiving boxes connected therewith. The ignition took the form of mild explosion or probably a series of explosions which ruptured the described apparatus. The unburned chemical was capable of supplying support for later combustion and it was this together with the light wood structure that furnished the initial hot fire.

There were nine stills or retorts located along the side walls of a room, about 85 feet by 50 feet, partitioned off from the east end of building by very light sheet iron nailed to light wood studs. Stills were of copper, steam jacketed set on brick. Capacity is said to have been about 150 pounds each. Individual gas heaters for heating the air supply and blowers for latter were located at sides and front of stills respectively.

The management states very positively that no other goods than salicylic acid were being manufactured at the time and that nothing else had been made for several weeks. Benzoic acid, in process probably of equal hazard to salicylic acid and acting very similarly to the latter under fire conditions had not been made for six weeks, but was stored in the burned section of the plant. There was some liquid acid on the premises used in processes but no nitric acid except, as it was claimed, in small quantities for laboratory purposes. Newspaper reports made mention of chlorine gas as having been manufactured. It was said by the management that chlorine had been used with toluol in manufacture of benzoic acid in a small detached building and neither of these two seems to have been involved. A certain Kaye process about which nothing could be learned was located near the burned room, this too probably was not a factor. There were two oxygen cylinders said to have been used in connection with lining lead tanks. The oxygen seems to have "gone up" during an early stage of the fire—the safety valves are said not to have worked. Nothing else of special importance, so far as could be learned, was within the plant.

Extent: The fire started near the northeast corner of the British-American section and burned toward the southwest, against a twenty mile wind. It stopped at the east, south, and west walls and at the second line of columns from the north wall, 41,000 square feet or 83% of the section or 40% of the whole building was destroyed. Practically all of the south and west walls will have to be rebuilt.

Cause of Large Loss: The cause of the large loss seems to have been the result of a combination of circumstances. It is clear that the sprinkler system in and about the room operated—in part at least—witnesses say that it was properly working. There had been a smaller fire of similar nature about the same time of day just one week previous in which four sprinklers operated and played the main part in extinguishing it. The sprinklers were undoubtedly slow to operate because of their corroded condition,—corrosion and loading had been noted in recent inspection reports resulting in the management being advised to replace sprinklers throughout with heads coated to resist corrosion. The four fused sprinklers in the early fire

had been replaced with Globe type. It is to be regretted that the management did not report the fire occurring on October 6th, because it appears from the rather meagre description of it that more than four sprinklers should have operated. A competent examination of the remainder would have lent valuable knowledge bearing on the later fire.

Two Rockwood heads found on fallen pipe after the second fire were burned down to the valve caps, the copper caps remaining in position soldered to the partially fused seats. These sprinklers were on systems supplied by different risers. Lack of information makes it uncertain whether these failed because of lack of water (through portion of pipe system having been plugged) or because of effects of corrosion and/or loading.

The sprinkler system did not hold the fire in any stage. Insufficient data, however, were developed to ascertain whether the fire was not too much for such protection even though it was capable of its intended efficiency. It is certain, nevertheless, that the progress of the fire after 4.30 a. m. rendered the equipment of little or no value, for it was about this time that the first section of the roof fell taking, of course, the sprinkler system with it. In fact it is, in all probability, this protection that caused the roof to hold as long as it did, carrying an uncontemplated load of sprinkler pipes, pulleys, shaftings, machinery and the necessary hangers, etc. The roof supports consisted of only six-inch by six-inch wood posts, fifteen feet long spaced seventeen feet by twenty-one feet.

The important point in connection with the cause of the large loss was the failure of the Fire Department to get to work promptly, partly due to the failure of those in the plant to notify the department when the fire was discovered, and the failure of the department to work within the building, which they seem not to have done at any time. Certainly if they could not have successfully operated on the lee side, which was tried, there was plenty of opportunity with comparative comfort to work in on the windward side of the fire.

As noted, part of the roof apparently went in about half an hour after the fire started and ten minutes later the fire assumed a sufficiently dangerous aspect to compel the officer in charge to call for more apparatus. The second alarm was sent in at 4.43 a. m. from which time the fire burned seemingly unresisted (except by a twenty mile breeze) a distance of 150 feet dead against the wind to the far walls. In the meantime another call for more apparatus was ordered. With the exception of the contents at the point where the fire started and the burning roof—and the rumor that the building was occupied by a chemical concern,—the department seems to have had little to contend with. The interior was not congested, the machinery and fixtures were mainly incombustible, except for the tanks which were full of water; the building was a low one-story affair—accessible from all sides and the roof, and was equipped with sprinklers—all conditions contributing to average good fire fighting.

Physical Features: The British-American Chemical Company occupied the west half of the building. It was separated from the

L. W. F. Engineering Company, manufacturing aeroplanes in the east half, by a two cell terra cotta block wall reinforced with brick piers to take the roof loads. A large and otherwise non-standard fire door was fitted on the only opening. This door was burned out but intact on the opening after the fire. The other walls were similar in construction to the wall described—were about fifteen feet high, but contained numerous wired glass windows and wood doors. The roof was built of seven-eighths inch matched boards, composition covered on three-inch by ten-inch joist spaced two feet on centres; in saw tooth form having wired glass lights facing the north. Supporting timbers were twelve-inch by six-inch on six-inch by six-inch posts and the brick piers in the walls. Floor was concrete.

Office (referring to the burned section), laboratories and employees' room were located in the unburned portion at the north wall. These were enclosed by wood partitions; about the only other partition was the light metal one enclosing the still room. This partition is said not to have extended up to the top of the saw teeth. Dry rooms were of fire-resistive construction. About the only platform of account that was burned was sprinklered.

Management: It is difficult to describe the management in view of the fact that it allowed the night force to be in charge of a man who permitted desertion of an admittedly dangerous process. They were foreign—English and German. The chemist under whose direction the plant was operated is said to be a Bavarian. About a year ago the plant of this company, then in Pittsburgh, burned down in a fire said to be due to exposure. Inspection reports show no criticism on the housekeeping score. The management, however, does not seem to have thought much of outside fire protection ideas.

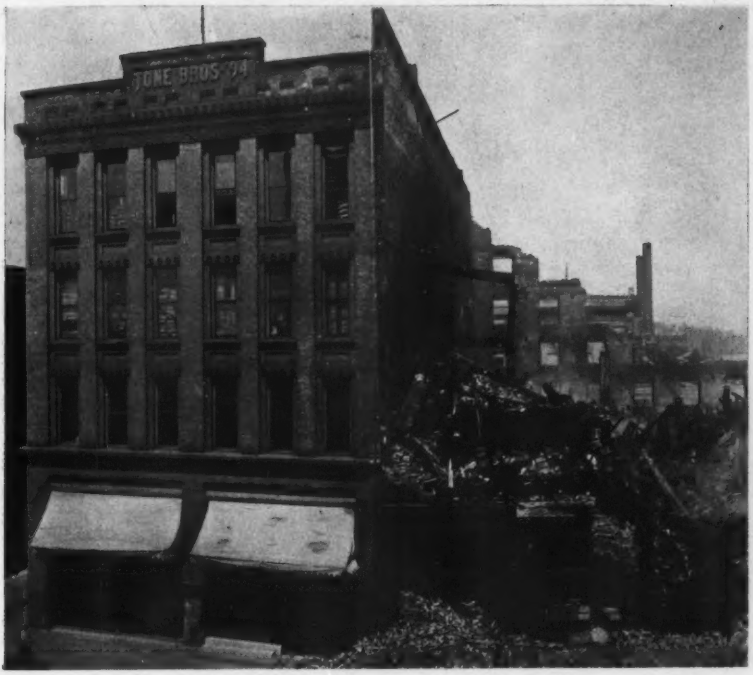
How Fire Was Fought: From the inside by the sprinkler system. A section of the roof seems to have fallen about thirty minutes after the fire started. It of course carried part of the equipment with it, and successive falling sections carried down more of the system. A break at the top of the southeast riser permitted the discharge of a six-inch stream. This was shut off about 6.00 a. m. A similar break at the southwest riser, but discharging much less water, was shut off at 9.00 a. m. The other two risers, on the north wall, were shut off about the same time as the first. Due to low water pressure after the break of the first riser and the use of water by the Fire Department, the sprinklers did not cover the roof with any kind of effectiveness. Portions of the roof adjoining the wrecked part very clearly show the effect of the sprinklers. The space between joists over each sprinkler was untouched by fire, while the intermediate spaces were completely burned out. The employees drew a line of hose of standard specifications from the southwest hydrant through the plant to the door of the still enclosure, but had to abandon their position before the Fire Department got into action. This line was left in the plant and later another was taken off same hydrant to protect the out-buildings nearby. After a time the department took charge of this stream.

The hydrant and the four risers drew from an eight-inch dead-end yard-main supplied by six-inch and eight-inch metered connections to a twelve-inch public main and a 75,000 gallon tank having heads normally of sixty and forty-five pounds respectively.

The fire department in addition to the mentioned stream operated three hydrant streams on first alarm and later four engine streams, and did not at any time report a lack of water. As has been stated the department did not, according to reports, enter building until the worst was over and did not fight fire at all from the south and southwest. One engine company got ready for action about 5.00 a. m. but did not go to work. The damage had then been done.

Effectual efforts on the part of the department, who took a line of hose through this section and worked at and on the east door of the burned section, and the employees with chemical extinguishers, kept the fire out of the aeroplane factory. The roof there shows signs of fire but there was not sufficient heat to operate any of the sprinklers.

In Conclusion. The lessons of the fire are obvious, and they have been taught many times. Preventive recommendations had been ignored, the employees failed to tend the stills, the watchman failed to send in the alarm, the sprinkler system failed to stop the fire, and the Fire Department failed to hold it.



The fire wall which saved the Tone Bros.' Building.

Fire in a Hardware Store, Des Moines.

August 11, 1917.

Special Report by Iowa Insurance Service Bureau, K. L. Walling, Publisher, (Member N. F. P. A.)

Construction and Occupancy: Building of semi-mill construction, approximately 85 by 130 feet with six stories and basement; walls of brick, the west or supporting party wall being 24-20-16-16-16-16 inches and the east or independent supporting wall being 28-16-16-16-16-16 inches; floors of ordinary wood joisted construction supported on each floor by six rows of wood posts; one open stairway and open elevator shaft from basement to sixth floor with all floor-way openings protected by iron clad traps with fusible links; composition roof. Built and owned by Brown-Camp Hardware Co. and entirely occupied by them as wholesale hardware warehouse, salesrooms and offices. Three sides with street frontages.

Private Fire Protection: One A. D. T. box on each floor and night watchman making rounds every two hours.

Public Protection: Under full City protection, five blocks from Fire House No. 1, with adequate number of double hydrants on large mains.

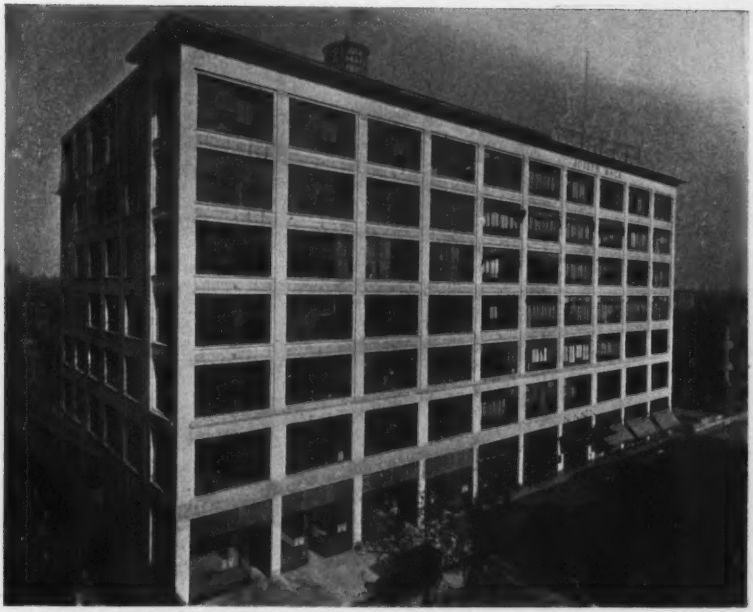
Discovery and Alarm of Fire: The night-watchman made his rounds at 7 p. m. detecting no signs of fire. At 8:40 p. m. he and the sales-manager, who was in the office, heard a noise which sounded as though someone was trying to break in through the metal doors at the rear of the building. Passers-by said this sound was as of an explosion within the building. Attempting to go to the rear of the building to investigate, the sales-manager and watchman found the building, outside of the office, filled with smoke which seemed to be coming from the second or third floor through the stairway and elevator openings. They telephoned an alarm direct to the Fire Department which was recorded at 8:50 p. m. Before the first companies arrived, smoke and flames were issuing through the roof. Two Assistant Chiefs with two pumpers, two hose wagons, two hook and ladder companies and two auxiliary companies responded to this call and laid ten lines of hose. A second alarm at 8:52 p. m. called out three hose companies and one truck company. A third alarm at 9:11 p. m. called out three hose companies, three pumpers and one truck company. In all, twenty lines of hose were laid which, with Siamese couplings, made ten streams including one attached to the sprinkler system in the adjoining building. It was seven hours before the fire was under control and it was confined to the building in which it originated.

The loss in the adjoining building, occupied by Tone Bros., wholesale coffee house and spice mill, consisted of damage to the party wall and water damage, principally in the basement. This building which was cut off by a solid fire wall is sprinklered throughout, but sufficient heat entered through a broken skylight of substandard construction to operate one sprinkler in the top floor.

Origin of Fire: The cause of the fire is not known. It is thought to have started on the second or third floor, at the east side. The stock carried at this point consisted of cases of loaded shells and of mixed paints in sealed cans. It is thought that the fire was of incendiary origin though there is no tangible evidence obtainable at this time to support this theory. The only employee in the building during the afternoon of Saturday, the day of the fire, resigned his position on the following Monday.

The complete destruction of all floors above the grade makes any investigation impossible.

Property Loss: The Brown-Camp building was valued at $96,000, and the loss is estimated at $65,000. The stock was valued at $361,000, and the loss is estimated at $310,000. Tone Bros. building is valued at $43,000, and the contents at $151,875. The estimated building loss is $3,390, and the estimated contents loss is $13,796.



Exterior of Joseph Mack Building a few days after the fire, showing little or no damage to outside of building.

Film Exchange Fire in Joseph Mack Building, Detroit.

November 16, 1917.

Special Report by Michigan Inspection Bureau, George W. Cleveland, Manager, (Member N. F. P. A.)

Construction and Occupancy: New seven-story fire-resistive addition to original Joseph Mack Building. Area, 78 feet by 100 feet. Reinforced concrete fire-resistive construction with tile, gypsum block, hollow metal and wire glass partitions. Building located on edge of congested section in old residence portion of city, and occupied principally by a printing establishment (on the 7th floor) and moving picture film exchanges. The general layout anticipated the film exchange occupancy for 2nd, 3rd, 4th, 5th and 6th floors, cut off from old building by hollow tile walls and single sliding fire doors. Each exchange was provided with from one to four film vaults constructed of 8-inch brick walls, kalamein type doors on ordinary hardware, building forming ceiling and floor.

Private Fire Protection: Equipped throughout with an approved system of automatic sprinklers served by a 25,000 gallon gravity tank elevated 25 feet above roof, a 6,000 gallon pressure tank, and one 4-inch siamese fire department connection.

Interior of film exchange, looking east from vault.

Public Fire Protection: Full equipped municipal fire department with ample hydrants on fair sized water mains. Accessibility good.

Story of the Fire: Fire started in a film vault on the fifth floor, from sparks from short circuit from temporary electrical connection made from lamp outlet in ceiling of vault. The sparks fell on open films piled on floor, and the flames spread to and destroyed the entire contents of the vault, also films on trucks on floor outside of vault and in open metal cabinets adjacent. Small water damage was noticed to paper posters, office furniture and fixtures. Building decorations in the lower floors also suffered water damage. Rapid expansion of heat buckled some light metal partitions on the floor of the fire. The blaze was confined to small section of fifth floor. An alarm was received at Fire Department headquarters at 6:56 p. m. from private watchman, one department company responding. On arrival of Fire Chief second and third alarms were turned in, bringing total equipment of six fire companies and two aerial trucks. Two hose lines were run up fire escape and one up stairway. Two 2½-inch hose lines were connected to the siamese fire department connection to the sprinkler equipment, one from each of two automobile pumpers. The work of these hose streams is reported to have been confined to extinguishing small fires shielded from the operation of sprinkler heads. Total gallons pumped reported to be about 12,000.

Sprinkler Equipment: The two sprinkler heads inside the vault, and a total of 55 in all apparently opened very promptly, as is shown by the low fire damage. Gravity tank and pressure tank were drained, evidently extinguishing the main body of the fire, for the reason that the two automobile pumpers, each having other hose lines in service, were blocked from delivering an effective water pressure and volume.

Loss: On building adjusted at $18,236.96, confined entirely to finish and decorations; on contents, outside of films, small.

Conclusions: While automatic sprinklers did very effective work in confining the fire damage almost entirely to the films, the ineffectiveness of water on films not enclosed in substantial metal containers is again clearly demonstrated.

This fire is only a repetition of many fires in institutions of this nature throughout the country, illustrating the necessity for observance of the following precautions:—(1) numerous small fire-resistive vaults or cabinets with normally open vents, and fire doors that remain operative; (2) absolute prohibition against keeping films, except the one being inspected, outside of these vaults or cabinets; (3) all films to be kept in substantial metal containers; (4) absolute prohibition of tobacco smoking; (5) municipal regulations severe enough to overcome the almost universal carelessness and disregard of hazards common with operators of motion picture exchanges; (6) sealing of all floor openings and provision of scuppers for floor drainage.

Interesting Electrical Fire.

We are indebted to the courtesy of one of our members for the following account of a very unusual electrical fire.

Cause of Fire: Fire was caused by the accidental contact of a trolley feeder with the fire escape of a tenant building located at a street corner. The fire escape extended from the first to the fifth floors, with platforms at each floor. The supports were loaded in the stone wall, except at the top floor, where they extended through the wood cornice, wall and inside wood sheathing, with an iron plate and nut inside (Fig. 3, and Fig. 4, letter "D"). The point of contact with the trolley feeder is shown in Fig. 2, and the arc, which lasted until the 250,000 circular mils feeder fused and fell apart, fused the fire escape railing.

The plate and nut ("D" in Fig. 4), was in contact with an unused gas pipe ("E" in Fig. 4), which in turn was also in contact with roof drain ("F" in Fig. 4). This formed the path of least resistance to ground and current travelled up the fire escape, to the fifth floor, melting metal at several points where the contact was poor. The heat generated by the resistance caused by poor conductivity of leaded joints of sewer pipes, ignited adjoining wood sheathing as shown in Fig. 5. and caused most of the fire damage. Small outbreaks were started by the same cause in different sections of the building, namely

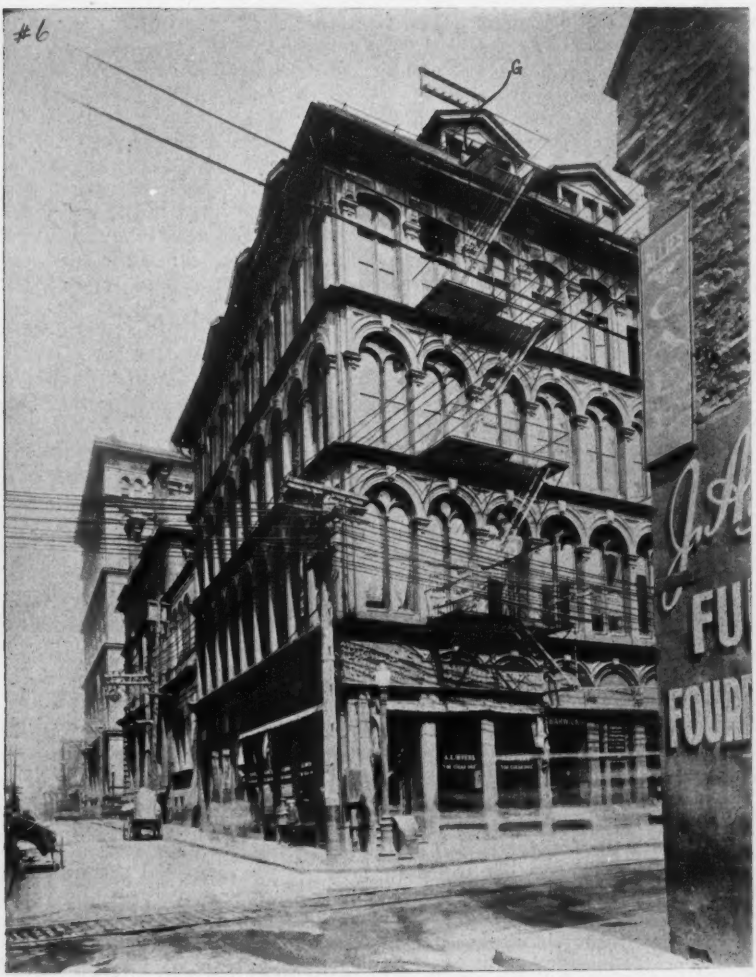


Fig. 1. Shows points of contact (F) between electric wires and fire escape, and fused rod (G) seen in Fig. 3.

on the fifth floor, front and rear, in toilet of fifth floor and in the basement. The leaded joints of the cast iron sewer pipes were melted in several cases and flowed to the floor where pipe runs were horizontal. In several cases where domestic water pipes passed in proximity to sewer pipes, the current jumped from one to the other, causing an arc which melted both the water and drain pipes. Cases are shown in Figs. 5 and 6.

Fig. 2. Fire Escape at second floor. Shows trolley feeders (A) point of contact with fire escape and fused rod (B).

The water discharged from damaged domestic water pipes, particularly on the 4th and 5th floors, caused a good proportion of the water damage, as valuable time was lost before control valves and stop cocks could be located. Quick action on the part of the Salvage Corps cut down to a great extent the water damage on the lower floors.

Fig. 3. Fire escape and cornice, fifth floor, showing fused iron rod. The end of this rod is seen in Fig. 4. (letter D).

Alarm Service: The blaze was spectacular at first as the arcs caused at point of contact of trolley feeders and fire escape and at the fused fire escape rod at the fifth floor level must have been very brilliant. A public fire alarm box was pulled by a passer by. Inspectors arrived with the fire brigade and at that time the trolley feeder had fused and fallen to the ground. The cornice near the fire escape was ablaze and when inspectors reached the fifth floor, one

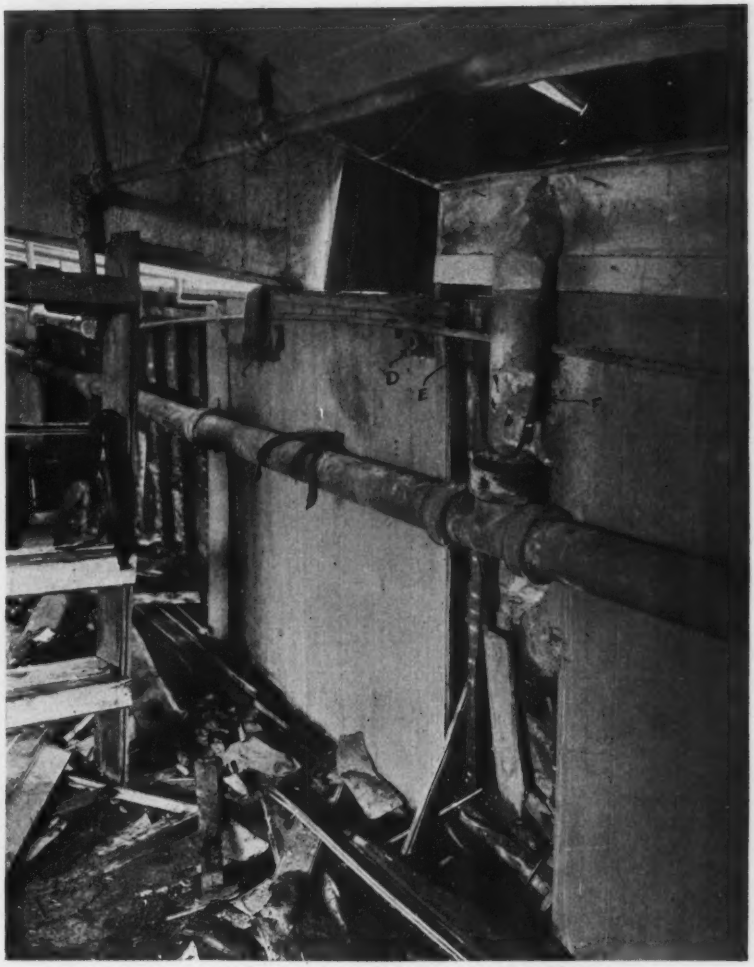


Fig. 4. Fifth floor interior. Shows nut and plate (D) at end of fused rod in Fig. 3, unused gas pipe (E), roof drain (F).

sprinkler was operating near front wall. The outside lever alarm valve did not operate. The sprinkler control valve was shut by inspectors about five minutes after they reached the building.

Extent of Fire: All of the fire damage was caused on the fifth floor and the sprinkler operating held the fire in check at that point, but two streams had to be used intermittently to extinguish the blaze

Fig. 5. One of the several sewer pipes damaged or fused by heat generated by resistance caused by poor conductivity of leaded joints. Note the charred sheathing.

which extended to the blind roof space and outside cornice. Chemical extinguishers were also used to extinguish small outbreaks at other points.

The tenants of this section of the building had moved out most of their stock to new premises and the loss here was greatly reduced on that account. Heavy water damage was caused on the fourth floor, which was occupied as a clothing factory; on the first and

Fig. 6. One of the cases where electric current jumped from sewer pipes to adjoining water pipes, fusing both of them.

second floors the water damage was light as the stock, etc., was covered by Salvage Corps. The second floor was vacant.

Remarks: While the 550-volt trolley feeders were covered with a wooden sleeve where passing near fire escape, it is evident that such protection was not adequate and was damaged by the constant swaying and vibration of the wires. Rainy weather also made conditions worse.

Employees of the Street Car Company were at work immediately, and temporary cross arms, supported by the fire escape, were installed to keep the feeders at least 8 inches from the escape. Permanent independent supports should be installed without delay and the wires should be at least 12 inches from fire escape.

Points of Interest from Fire Reports.

These notes are intended to illustrate conditions making for or against effective control of fire.

Automatic Sprinklers.

S-19664-A. Tenant Manufacturing. A bed was provided for the watchman in a room off an open loft on the second floor. The watchman smoked in bed, and fire resulted. **The operation of one sprinkler, which entirely extinguished the fire, undoubtedly saved the watchman's life, as he had been overcome by the smoke, and was revived by water from the sprinkler.** He escaped with severe burns.

S-19682. Dock Storehouse. The sprinkler system had been shut off for the previous winter, as was customary in this property, but although the fire occurred near the end of May, water had not been turned on again, as the management had been waiting for a chance to test the system for leaks when the dock was empty. When the fire was discovered, it had gained so great headway that no attempt was made to turn water into the system. A loss of about $50,000 resulted.

S-19919. Metal Worker. A laborer ignited a match in the vicinity of a vat containing enamel and gasoline on the fourth floor of one of the buildings of this plant. Fire travelled up piping from the vat to dip tanks on the fifth floor, and owing to the presence of large quantities of gasoline spread rapidly. It is evident that the water from the sprinklers floated enamel from the dip tanks on the fifth floor, and that heat, with some fire, extended through open doors into an adjoining building, opening a large additional number of sprinklers. Meanwhile the flames had gained entrance also to the third floor, with the result that the total number of sprinklers operating was no less than 354, which soon drained the gravity tank which constituted the primary water supply. Owing to a leaky valve, or a valve having been broken, the fire pump which should have given a secondary supply was of little or no service. In consequence of this failure, the entire roof and the flooring in the top story of one building were destroyed, while extensive repairs were rendered necessary on the lower floors. There was heavy water damage in other buildings. Notwithstanding these difficulties, it was evident that the sprinklers were of considerable value in checking the fire. It was also apparent that, had the doors into adjoining build-

ings been kept closed, or had they been of standard automatic type, no damage would have been done beyond the building in which the fire originated.

S-19973. Celluloid Works. The night watchman of an adjoining plant observed water coming through the basement wall in large quantities. On investigation, it was found that fire had occurred, probably among oily rags, in the sheeting room, where 125 boxes, each containing 150 sheets of celluloid 14 inches by 20 inches in size, were in storage. The flames spread to the celluloid stock, the contents of 31 boxes being completely destroyed, all that remained being a black ash. With the exception of scorching on the inside, discoloration and slight burning around cracks, the boxes themselves were practically unhurt, and the remaining 94 boxes were undamaged by fire, though rendered practically useless by discoloration. The sprinklers had, however, entirely extinguished the fire.

S-20046. Knitting Mill. Although this fire, which was caused by a foreign substance passing through a Bramwell feed, was entirely extinguished by sprinklers, a loss of nearly $4,250 occurred. By far the larger part of the damage was the result of delay in shutting off the water. **No one on the premises was familiar with the location of the controlling valve.**

S-20210. Cold Storage Plant. Spontaneous ignition of rubbish in the sub-basement is thought to have been responsible for this fire. Both basement and sub-basement were equipped with dry pipe sprinklers supplied by Siamese steamer connection at the sidewalk. Great credit is given to these sprinklers as a factor in confining the trouble to the sub-basement. Many heads opened directly over the seat of the fire and enabled the firemen to throw a deluge of water where it would be most effective, though the men themselves were kept out by deadly ammonia fumes. It is thought that the water from the sprinklers absorbed much of the ammonia and carried it into the sewer, thus making it possible for the firemen to enter much sooner than would otherwise have been the case.

S-20381. Theatre. The cause of this fire is thought to have been a lighted cigarette or match dropped through a crack in the gallery floor to a small concealed space in the balcony ceiling. Fire passed up this space to a large space at the gallery landing where there were sprinklers and thermostats. Although fire was confined to gallery seats and concealed spaces, the heat spread to an attic and to apartments which formed the front part of the building. Thermostats, sprinkler alarms and sprinklers all operated. The property loss was considerable, but had the concealed space at the landing not been sprinklered, there can be little doubt that it would have been been much greater, and there would probably have been loss of life also.

S-20480. Woolen Mill. A bolt or small piece of metal getting into the stock while it was being transferred from the gauze rooms

was probably responsible for this fire in a Bramwell feed. It was stated that the stock was about 80% wool, but the fire seems to have spread very quickly, so that seven of the nine cards in the room suffered fire or water damage, and fire entered one of the gauze rooms. The quick spread of the blaze is attributed to the presence of lint, and perhaps piles of gauze, on the floor. Thirty-two sprinklers opened in the room and extinguished the fire, but it is probable that sprinkler protection in the feed would have prevented the flames from spreading beyond it. The damage was about $1,750.

Sprinkler Alarm Service.

S-19357. Tenant Manufacturing. The day fireman found water dripping through the ceiling and running down the stairway when he entered the building at 5.30 a. m. From the amount of water found on the various floors, it was estimated that a sprinkler had been in operation for about an hour, having practically extinguished a fire caused by a single burner gas plate, with rubber tube connections, which had been carelessly left burning on the previous night. The sprinkler alarm was connected to a rotary gong and an electric bell, neither of which operated. Investigation showed that the alarm cock had been closed. When this was opened and a test made, the rotary gong operated promptly, but the batteries were found to be run down in the case of the electric bell. The only explanation of the state of the alarm service was that the services of the employee who had been in charge of the sprinkler system had been dispensed with, and the new employee was not familiar with the operation of such devices. The loss was mainly water damage.

S-19818. Sash and Door Factory. Although there were two 12-inch electric bells located on the outside of the building and a 6-inch bell in the stableman's dwelling, none of these operated when the dry valve on the sprinkler system tripped. The fire was discovered by an outsider, and although 47 sprinklers opened and practically extinguished the fire, despite some obstructions to distribution, it would appear that the dry valves, which were of an old unapproved type, were slow in operation. The loss was $3,580.

This fire illustrates the importance of installing approved dry pipe valves.

S-20181. Clothing Factory. In this case the sprinkler alarm failed as the result of the placing of a piece of tape by some unknown person between the valve contacts. There was a moderate water loss.

S-20265. Tenant Manufacturing. At this fire the sprinkler alarm valve failed, subsequent examination disclosing a piece of wood lodged in it. Runners were dispatched from the central station when low pressure and ground signals were received, and one of these turned in an alarm. Five sprinklers operated for about two hours and held the fire in check. The loss was moderate.

S-20368. Shoe Shop. A loss of nearly $7,000 (largely water damage) resulted from this fire. The alarm service was limited to thermostats, which failed to operate—probably because a sprinkler head opened first and cooled a thermostat which was about to transmit the alarm. **Had there been a sprinkler alarm the loss would have been very much smaller.**

Watchman Service.

S-19748. Hatters' Fur Factory. Fire started in a pile of furs, about 5 feet deep and 10 feet by 15 feet in area. The watchman first smelled smoke on Saturday night, but failed to locate its origin. He informed the Sunday watchman, and they thought it might come from the boiler, which was banked over Sunday. On Sunday night the smoke was very thick, but no source was discovered. Early on Monday morning a watchman from another plant saw smoke escaping from the windows, and came over to investigate. The watchman at the fur factory said that there was no fire and that the smoke came from the boilers. The strange watchman, however, recognized the odor of burning fur, and caused the management and the fire department to be notified. Fortunately the loss was small.

S-19790. Mercantile. Fire evidently smouldered for a long time, a small hole about six inches in diameter being burned through a 4-inch floor. Two sprinkler heads opened and extinguished the fire when it spread to some nearby bins, but there was considerable water loss in consequence of the watchman wasting 45 minutes in getting into telephonic communication with the fire department, when he could have reached them through a street alarm box almost immediately.

H-11930. Wooden Box Factory. This plant was practically destroyed by fire originating in a poorly cut-off boiler room. The watchman discovered the fire and tried to send in an alarm through several A. D. T. boxes, but he apparently became confused, simply breaking the glass without transmitting an alarm. When an alarm was finally given by an outsider from a street box, the fire had gained great headway.

S-20108. Bobbin and Shuttle Factory. The watchman passed the location of the fire, smelled smoke, but could not locate the trouble, which was due to friction in a reaming machine setting fire to a bobbin. On returning to the engine room, he heard either the running water from the sprinklers or the sprinkler alarm, and tried to reach the engineer, who arrived in half-an-hour's time and shut off the water. The fire loss was about $10; the water damage exceeded $3,400.

S-20241. Loom Shuttle Factory. Prior to starting his 11.30 p. m. round, the watchman filled a small heater from an open sawdust bin. This bin had a small opening into the boiler room, protected by a wooden shutter. The watchman used a large wooden

scoop, and evidently carried fire from the heater to the bin. About five minutes after filling the heater he heard a crackling noise and, turning round, discovered fire. He stated that when he attempted to telephone to the fire department from the boiler room he was driven out by smoke. He then endeavored to attract the attention of the watchman of a neighboring plant, who, some 35 minutes later, turned in an alarm. The loss was $30,000.

S-20335. Candy Factory. Fire occurred in a stack of baled excelsior on a loading platform over the boilers. The watchman heard the sprinkler alarm, located the fire, and, supposing it extinguished, closed the controlling valve. The fire again broke out, and, instead of reopening the valve, the watchman attempted to call the fire department through a public box. He failed to do so, and, returning, opened the valve. By this time the heat had fused all the sprinklers in the loading area and two inside the building, with the result that all the water in the primary supply pressure tanks and half the water in the secondary supply gravity tank was discharged. The loss of $5,000 mostly represented water damage.

S-20361. Woodworker. The sprinklered section of this property suffered comparatively little damage—a water curtain being formed inside the windows—but a loss of between $150,000 and $200,000 was incurred in the unsprinklered buildings. The primary cause of the fire gaining such headway was that the watchman and another employee spent precious minutes in trying to extinguish the flames before sending in an alarm. Had the alarm been sent in immediately the fire might have been checked before falling debris could have broken a 6-inch connection from the yard into one of the buildings. This accident practically put the water supply out of commission for some time in the early stages of the fire.

The above seven fires indicate how urgent is still the need of impressing upon property owners the importance of employing as watchmen only men of proved intelligence and character.

Thermostats.

H-11847. Department Store. The conduit carrying the 550-volt direct current wires for elevator motors became alive with the wires in same. The watchman, in lowering a heavy vacuum cleaner on the elevator, caused the car to vibrate and swing. This made the annunciator cable under the car swing against the handling cable. As the cage of steel surrounding the elevator well was in contact with the live conduit and the annunciator cable was grounded on the cage, a circuit was completed. The annunciator cable was burned out, a coil in the same was destroyed, a small fire blackened an area of a few square inches under the car, an arc burned a hole in the steel cage and set fire to a piece of cardboard, and the annunciator wires in the basement were burned off where they came in contact with the live conduit. The watchman extinguished the fires under the elevator and in the cardboard with pails of water. The other fires died out of their own accord.

The peculiar feature of the fire was the automatic alarm transmitted by the thermostat system. It is not believed that the heat evolved by the fires was sufficient to cause the thermostats to operate, but a plausible explanation is that a light current was sent over the tube on the second floor, and that this instantly raised the temperature along a considerable length and caused it to operate in the same way as if the copper tube had been surrounded by heated air from a fire. The evidence at hand showed that the tube which transmitted the alarm was in contact with a wire holding elevator traps, and this wire was in contact with the live conduit. The sending in of the alarm was highly desirable.

Alarm Service Generally.

S-20182. Tenant Manufacturing. A sprinkler alarm connected to a bell on the premises was the only alarm service provided. There being no watchman or thermostats, a small fire due to defective or crossed electric wiring resulted in $15,000 water damage. Three sprinklers entirely extinguished the fire, but 14,000 gallons of water were discharged into the building during the night, causing loss on all floors of the building. It is not known whether the sprinkler alarm operated.

First Aid Appliances.

S-19668. Woolen Mill. Fire started in stock going through the rolls of a card, and is ascribed to a hot bearing on the machine. It spread from the machine of origin to three adjoining machines. 79 sprinklers opened and held the fire in check, but owing to the inaccessibility of the fire they were unable to extinguish it. A large amount of smoke was given off, and by the time hose streams were laid the fire could not be located. Consequently the room was flooded and a loss of more than $11,500 resulted. **From the nature of the fire it seems that with adequate hand equipment in the room and this equipment properly used, extinguishment could have been effected with comparatively small loss.**

H-11856. Patent Leather Factory. During a severe thunderstorm a fire was caused in the daubing room by lightning coming through the window and setting alight a pail of naphtha in which an employee was washing his hands. Fire was communicated to two tanks of daub nearby, but was extinguished with slight loss by employees with chemical extinguishers and shovels of sand. Sand proved to be far superior to the extinguishers for smothering the fire, but the extinguishers kept the fire from extending to the roof of the building.

S-20461. Paper Mill. This blaze, which occurred as the result of a hot bearing, was discovered promptly, and could easily have been extinguished, or at least controlled, by water pails or small hose, but the former were not nearby, and the latter was so deteriorated from age as to be useless. Hydrant hose was put in service and the fire pump started, but a wrong-sized coupling on a length of hose recently

purchased caused considerably delay and allowed the fire to gain headway.

Construction.

S-19681. Creamery and Ice Cream Factory. Ten sprinklers operated in order to extinguish a small fire, causing some unnecessary water damage. This was due to the unusual peaked roof with numerous light rafted supports and sprinklers arranged above, which seriously obstructed the distribution from the heads directly over the seat of the fire.

S-19800. Cotton Mill. Fire was discovered in a roving waste picker in the opener room. Two sprinklers opened and held the fire in check, and the extinguishment was completed by a bucket and extinguisher brigade with the aid of a line of small hose. The card room was immediately underneath, and water readily leaked through the floor, only a timely covering of the cards averting a bad water loss. **This illustrates the poor judgment used in locating the card room under the opener picker room.**

S-19983. Furniture and Mattress Factory. Fire struck in cotton stock in a picker machine which had been installed without enclosure and without rearrangement of high temperature sprinklers in a building formerly used as a dry kiln. The east and west walls of the picker room were of brick, and were built up to the bottom of the joists, but did not extend through the roof. The ceiling or roof of the building was wood sheathed, and in the picker room there were holes in the sheathing. Fire ran along the ceiling, under the wood sheathing, and crossed to a cotton storage room in the southeast corner. A number of joists were burned in the picker room and some were charred in the cotton storage room. A large part of the sheathed ceiling had to be removed before the fire was extinguished.

H-11860. Paint Shop. The shop was nearly full of automobiles for painting work, and, although the loss was heavy, the feature of the fire was the protection given five high-priced machines by double plank partitions which cut off some store rooms from the main shop. These automobiles were not damaged.

H-11927. School House. This was a one-story building with an area of 19,000 square feet, but no fire divisions. Fire is attributed to an overheated boiler smokestack in close proximity to wooden roof joists. It had probably been burning for an hour or so when discovered by residents in the vicinity. The firemen had difficulty in using hose streams to advantage, as the fire had gotten into an attic space. The tile roof, which was supported by light wood trusses resting on the walls, prevented access, and streams could not be played on the flames until portions of the roof collapsed. The roof, partitions and portions of the wood floor were destroyed, with a loss of $34,875.

Horizontal and Vertical Openings.

S-19990. Mattress Factory. When fire occurred in the second story of this plant, water ran through the hoist opening and the floor and drenched two garnetting machines. It then flowed over the sills of a fire door, into the first story of an adjoining building to the east, the floor level being lower in this building than in the mattress factory. Considerable damage was done here. On the other hand, no water entered a frame metal-clad cotton storage building to the south, which was cut off by a brick wall and a standard sliding automatic fire door with the sill raised above the first floor of the mattress factory.

This fire shows the importance of having raised sills at fire doors and floors pitched to drain.

H-11890. Metal Worker. While alterations were being made at this plant, a workman's hammer struck a spark against brickwork, and an accumulation of waste lacquer was ignited. The fire started at a lacquering bench on the second floor and spread over half this floor. The fire doors to the stair tower and wings all operated, and these, with superior brick construction, retarded the fire. The flames gained access, however, through a belt hole and travelling belt to all the upper floors. The contents were extensively damaged, but the building was intact, with the exception of broken windows and charred floors. The loss exceeded $15,000.

S-20149. Tenant Manufacturing. This was a basement and five-story brick building divided by fire walls into four fire sections, two of which were sprinklered. The fire started in the unsprinklered section and gutted the upper floors, causing a damage estimated at $60,000. There was practically no fire loss in the sprinklered section, although water loss was very heavy. Openings in the fire walls dividing the sprinklered from the unsprinklered portions on the second to fifth floors were protected by double sub-standard fire doors which were regularly closed at night, and did excellent work in the present case. The floors being slightly higher in the unsprinklered than in the sprinklered section, much water entered the latter.

Six sprinklers opened in the sprinklered building during the fire. Two of these, on the fifth floor, were probably opened by heat escaping through the fire doors, which were in two folding parts. Evidently one door had not been completely closed—unless it opened slightly from heat—as there was blackening of the wall and a very slight charring of roof timbers above it.

S-20338. Furniture Factory. Fire originated at the bottom of an elevator well which extended from basement to roof and was constructed of wood, tin-lined, with doors of similar construction. The elevator was at basement level, and fire evidently started beneath car, possibly as a result of spontaneous ignition of oily material.

Wood traps inside the elevator well at each floor level were not in commission and had been tied open. Fire burned the rope holding

these traps open and allowed several to drop into place. These formed a water shed from water thrown by one sprinkler located at the top of the elevator well, and therefore constituted serious obstructions. Two sprinklers operated on the first floor, three on the second, seven on the third and one on the fourth, in addition to the one at the top of the well. Elevator doors on the third floor had been left open, thus causing sprinklers to operate unnecessarily.

Thermostats operated and gave the alarm. The loss was considerable.

S-20340. Artificial Leather Factory. This fire spread so rapidly that a number of employees barely had time to escape. Starting in the mixing room near the fire doors into the coating room, it flashed through the doors before they closed, and also made its way through a belt opening. 169 sprinklers opened and practically extinguished the fire, but not before damage in excess of $15,000 had been done. The cause is thought to have been static electricity igniting combustible vapors at a mixing churn.

S-20468. Tenant Manufacturing. This was a severe exposure fire, and the water damage from the 232 sprinklers which opened was very heavy. The fire loss was slight. Much of the damage might have been averted had the goods been skidded on all floors. **The main interest of the fire, however, is that it illustrates the serious consequences resulting from large, unprotected windows in otherwise well constructed and protected buildings. Although it is probable that, even with wired glass windows, some sprinklers would have opened, it is certain that the building and contents would have suffered very much less.**

Roofing.

H-11807. Tannery. Fire occurred in the leach house from an unknown cause, and had gained considerable headway when discovered by the watchman. The leach house was practically destroyed, and the asphalt shingle roof of the adjoining tan yard was damaged for a length of about 50 feet. This roof was badly charred where directly in the path of the flames and was burned through in places, but its slow burning qualities played an important part in retarding the spread of the fire.

S-19816. Morocco Leather Works. A railroad line ran close to this factory, with a strip of thick grass about five feet wide between the grade and the side of one of the buildings. Fire started in the grass, evidently from a hot coal from a locomotive fire box, and spread fanwise until it reached the building. The loss was slight, partly owing to the early discovery of the fire and the prompt work of the fire department and partly because of the fire-retarding action of the sand-coated composition roofing with which the side of the building was covered.

Fire Departments.

S-20146. Mattress Factory. Employees were fighting this picker fire with small hose and sprinklers operated by a manual valve when some unknown person sent in an alarm to the city fire department. The department, on its arrival, deluged the second floor with water for two hours, saturating two carloads of excelsior and causing the floor to collapse, carrying the sprinkler pipes and first floor to the basement. The fire did not generate sufficient heat to open any automatic sprinkler heads, and the actual fire loss is stated to have been about $25. The total damage amounted to $6,600.

H-11936. Theatre. Fire started, just after a performance, in a small room under the rear of the second balcony, in which some old seat cushions were stored. It burned upward through the gallery floor and through the ceiling above the gallery to a blind attic, having gained considerable headway before being discovered. In view of the difficulty of fire fighting in such a location and of the large amount of light wooden bracing for the auditorium ceiling and gallery floor, the fire department performed a remarkable feat in stopping the fire there. Between forty and fifty firemen were temporarily overcome by smoke from the burning upholstery.

Open Sprinklers.

S-19417. Corset Factory. Water was promptly turned on the outside sprinklers when fire occurred in a neighboring factory. A small amount of glass was cracked by the heat, but the turning on of the sprinklers without doubt saved damage to the window frames, and also prevented the inside sprinklers from opening, which would have resulted in a much larger loss. There was some leakage around the windows and water running in damaged a small amount of stock.

S-19831. Tannery. Sparks from a chimney ignited the shingle roof in several places. The flames were quickly extinguished by open sprinklers on the ridge pole, aided by pails and chemical extinguishers. The damage was slight.

Miscellaneous.

S-19270. Chemical Works. Fire was caused by the breaking of the unduly small brass globe valve of a fuel oil burner used to heat a process kettle, which allowed oil to discharge and become ignited from a torch or other oil burners. Alterations were in progress at the plant and, just before the fire occurred, a sprinkler foreman shut the valve under the gravity tank preparatory to removing a plug from an underground tee so as to make a connection with a new system in a new building. Employees in the room within twenty feet of the point where fire started stated that there was a rush of flame up through the roof and over the center and westerly part of the roof entirely without warning. The oil valve in the supply pipe near the door is said to have been shut by employees within a few minutes, but the fire obtained a hold almost immediately in the pine

staging around kettles, bridges, stairways and wooden hood over kettles. In connection with the alterations already mentioned, a part of the roof of the one-story section where the fire occurred had been removed, and a window on the second floor of an adjoining main building had likewise been taken out. Flames shot through the roof opening and entered the open window; they were also sucked through a hole in the wall into a wooden vent pipe which passed up through the floors and roof of the main building to an exhaust fan in a pent house on the roof.

As soon as the sprinkler foreman discovered that there was a fire, he hastened to open the gate valve under the gravity tank, reaching this just as the plant whistle gave the alarm. The fire pump was started up and operated at about the same time. Three or four minutes are said to have elapsed before water reached the sprinklers, and as soon as water began to be discharged two or three lines of piping fell. The reason for the fall of at least two of the pipes was that the cast iron rings of the adjustable clip hangers had been heated nearly red hot, and the sudden dash of cold water caused them to break. About four hangers came down as a result of the 1½-inch screws being pulled out of the charred plank roofing, the charring being over half an inch deep.

Considering the fact that the sprinklers directly over the fire were badly crippled and that water was shut off during the first three or four minutes, the sprinkler protection was satisfactory. The sprinklers did at least half the fire fighting. Out of a total of 63 heads in the section of origin, 48 opened; 4 heads in the second story of the main building near the open window and the wooden vent pipe, together with 2 heads on the third floor near the vent pipe also operated, and did good work in stopping the fire there. The fire department, the employees and a construction and wrecking crew who were on the spot all acquitted themselves well. The single standard automatic sliding fire doors on the first, second and third floors of the main section were closed by hand in cases where they had not already closed automatically. They operated well and stood the fire test satisfactorily. Sacks of commercial naphthalene piled within ten feet of the fire were slightly damaged, as the burning oil caused part of the burlap bagging to ignite. More or less of the naphthalene was melted and damaged by fire and water, but little, if any, seems to have burned.

S-20160. Mattress Factory. Waste in the fire-resistive chamber of a willow machine was ignited by a spark struck in the machine by a piece of metal in cotton stock. Employees had been instructed in such a case to stop the machine, to open the trap in the side of the machine, to pull the ignited stock out of the compartment and to extinguish the fire with pails of water. Instead of doing this, one employee opened the trap, while another threw a pail of water into the burning mass, with the result that a burst of flame ignited cotton waste on the men's clothing. One of the men was probably fatally burned, the other badly injured. Nine sprinklers opened and held the fire in check until the arrival of the fire department.

H-11884. Tannery. About three months prior to the fire, the private fire-fighting facilities at this plant had been seriously impaired by a severe flood, the greater part of the hose and all the hose houses having been washed away and destroyed. **These had not been replaced at the time of the fire.** The electrical equipment had also been severely damaged, and though it had been completely overhauled a short time before the fire, it had not been inspected since the overhauling. The fire was not discovered until it had gained much headway, and the fire department had to travel a distance of two miles over streets in poor condition. The fire pump was operated by employees until the pump house was seriously endangered by the burning building and had to be shut down. Hose was missing at many of the standpipe connections inside the buildings. The frame finishing building, dry lofts and storage, together with all machinery and contents, were practically a total loss. A service tank and liquor vat nearby were severely damaged, and the roof and west wall of a tan yard addition also suffered slightly. Great credit is due to the fire department for confining the fire to this area, as there were other large frame buildings in the vicinity.

H-11926. Foundry. This plant would assuredly have been a total loss but for the assistance rendered by the management and men of a neighboring mill, which happened to be equipped with a pump and hydrant system. **The foundry had no private water supply, and there was no public protection in the village in which it was located.**

H-12035. Chemical Works. A loss exceeding $66,000 resulted from this fire. Heat from the power boilers is supposed to have ignited the roof of the frame boiler house, and the flames spread rapidly to the main building (brick walls, fair joist construction) through unprotected openings at the first and second floors. By the time the fire department arrived the blaze had gained great headway. **Two large iron stacks or towers containing crushed coke through which an alkali solution flowed by gravity passed through the second floor and roof, and were not otherwise braced or supported.** The heat of burning timbers weakened the stack or tower nearer the boiler house, causing it to fall directly over the main building, carrying the roof and second floor timbers with it. One of the firemen was buried and two other men were injured. Hose streams were then mainly directed at this point with a view to extricating the fireman under the timbers and coke from the falling stack. There were numerous charged gas tanks on the first floor, but none exploded, as safety valves operated properly. The main portion of the plant was practically destroyed.

It was stated that employees wasted twenty minutes fighting the fire with a garden hose before sending in an alarm. The fire alarm box was just across the street.

H-12163. Chemical Factory. Highly inflammable material in an ordinary joisted building with unprotected floor openings contributed to the rapid spread of this fire. Within ten minutes after its discovery in the basement, flames had reached the second floor by means of the elevator shaft, and shortly afterwards were observed bursting through the roof house over the shaft. Dense black smoke and intense heat accompanied by numerous slight explosions marked the fire. **The iron fire escape in the midst of the flames became white hot.**